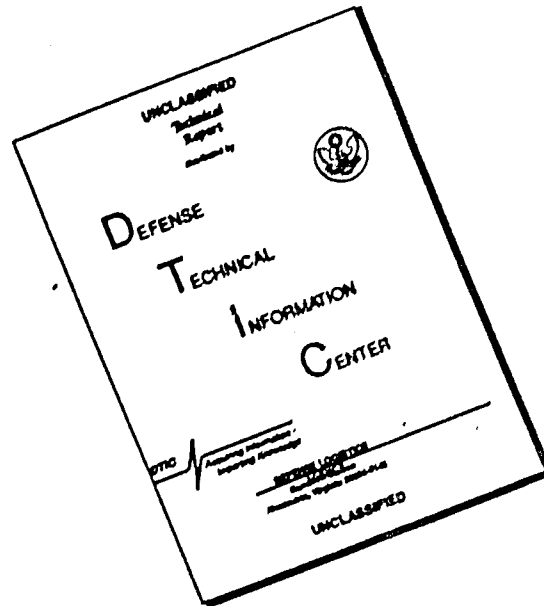# AIR FORCE

SCIENTIFIC RESEARCH

BIBLIOGRAPHY

VOLUME VII

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AFOSR 700 - VII

AIR FORCE SCIENTIFIC RESEARCH BIBLIOGRAPHY 1963-1964

by

Thomas C. Goodwin
Doris C. Yates
Norman G. Lamb
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Phyllis M. Martin

Special Bibliographies Section
Science and Technology Division
LIBRARY OF CONGRESS

FOREWORD

The guiding concept of this series has been to provide high quality bibliographic accessibility to a highly specialized body of literature-- the scientific results of research supported by the Air Force Office of Scientific Research in university, industrial an' other laboratories worldwide. Among the objectives have been completeness, convenience and usefulness. Completeness has been sought by comprehensive literature searches performed by the Library of Congress staff. Convenience has been provided by the kinds of indexes included, making it possible to find citations by reference to contract numbers, for example, in addition to authors, subjects and institutions. Usefulness has been in having a separate channel for Air Force research, packaged for ready reference.

This bibliographic series has met these objectives. When it began, its only alternative was not doing it at all. Since then the Defense Documentation Center System, in conjunction with the Clearinghouse for Federal Scientific and Technical Information, has broadened its services, has become largely automated, and is now in a position to assume many of the functions of this series. Thus it is possible to say that while this series is desirable its function is no longer exclusive. Therefore this volume, covering the period 1963-1964, will be the last of the series to be issued. While the services of DDC and CFSTI may not be as immediately accessible as these volumes have been, it is believed that most of the users of this series will be able to meet their requirements by using them. Limited literature searches are available from DDC, for example, at no charge to qualified requestors. The public will find that the Clearinghouse offers somewhat comparable services. Inquiries may be directed to DDC, Cameron Station Alexandria, Va. 22314 and to CFSTI, U.S. Department of Commerce, Springfield, Va. 22151. Descriptions of their complete services are available upon request.

I wish to extend to the Special Bibliographies Section of the Science and Technology Division of the Library of Congress the thanks of AFOSR and of users of AFOSR-supported research for a most competent undertaking. Harold Wooster deserves special credit for planning and guiding this series through the twelve years of its existence.

William J. Price
Executive Director
Air Force Office of Scientific Research

PREFACE

This is the seventh volume of a continuing bibliographic series, and includes within the limitations of the law of diminishing returns, abstracts and approximately fifty percent of all technical reports, journal articles, books, symposium proceedings, and monographs produced and published by scientists supported in whole or in part by the Air Force Office of Scientific Research during the calendar years 1963-1964. Previous publications in this series have been:

Vol. I (1950-1956), issued in 1961
Vol. II (1957-1958), issued in 1964
Vol. III (1959), issued in 1965
Vol. IV (1960), issued in 1966
Vol. V (1961), issued in 1967
Vol. VI (1962), issued in 1968
Vol. VIII (1965), issued in 1969

The Air Force Office of Scientific Research supports fundamental research in the six major scientific disciplines: physics, chemistry, engineering sciences (subsuming electronics, mechanics and propulsion), life sciences (both biological and behavioral, but not medical), mathematics, and the information sciences. Thus the publications abstracted herein are multi-disciplinary, their common link being task support by AFOSR.

Sources Searched

References, reports, and clues to the existence of reports were found by searching the indexes and report collection of the Air Force Office of Scientific Research Technical Library, and the collection of the Defense Documentation Center. Detailed searches were made of each contract file in the several AFOSR Directorates. Due to funds and time limitations, the usual cover-to-cover searches of scientific journals were excluded for the period 1963-1966.

Form and Entry and Arrangement

Inherent in the organization of this book is the concept of the reports within a contract as an unanalyzed monographic series. Reports are posted chronologically and/or alphabetically under contracts, these in turn under departments or laboratories, and those under contractors. This does, in fact, provide a rough subject grouping with the detailed subject index leading into clusters of like reports.

The abstracts are identified by item numbers and are listed under the numbers in the indexes. The form of entry is, in general, that being used for DDC catalog cards i.e., source of the document; title; personal author, if any; date; pagination; report number; contract number; and accession number. The chief exception to DDC form of entry is that the primary entry is by the parent organization followed by the name of the specific laboratory or important subdivision.

Availability of Reports

The principal accession or control numbers, which indicate the locations of reports in collections are:

AD ASTIA Document or Accessioned Document:
(available at DDC, Defense Documentation
Center), Cameron Station, Alexandria,
Virginia 22314.

PB (Publication Board): for sale by the
Clearinghouse for Federal Scientific and
Technical Information (CFSTI), Sills
Building, 5285 Port Royal Road, Springfield,
Virginia 22151.

The fact that a report is abstracted in this book means that a copy of this report existed at the time the abstract was written; it should not be construed to imply that either AFOSR or the Library of Congress necessarily has a copy available for distribution. Those seeking reports should do so from the cited agencies, not from AFOSR.

Indices

A detailed subject index, arranged alphabetically, has been provided. In addition, there are an AFOSR control number index and a personal author index.

Acknowledgements

Many people shared in the production of this volume. The work has been fostered and nurtured by the previous Commanders and Executive Director of Air Force Office of Scientific Research: Brigadier Generals H. F. Gregory and B. G. Holzman; Colonels A. P. Gagge, Jack L. Deets, and Ivan Atkinson; Dr. Knox Millsaps and the present Executive Director, Dr. William Price. During the period of compilation of this volume (not the period of the literature covered) much of the responsibility for documentation within AFOSR was transferred to the Office of the Assistant Executive Director for Research Operations, Lt. Colonel Harry Jaffers. He, his administrative assistant for documentation, Miss Arlene D. Blose, and their intermittently faithful computer have been in large part responsible for providing the AFOSR input in this volume.

Library of Congress, protocol dictates the form and order of acknowledgement of contributions made by LC staff members to a bibliography. Formally, the credit lines read as follows:

"The bibliographic team worked under the guidance and leadership of Thomas C. Goodwin, Jr., Head of the Special Bibliographies Section, Science and Technology Division. The chief workers on this volume have been, Doris C. Yates, Norman G. Lamb, Marion S. Carr, and Phyllis M. Martin. A special note of gratitude is due to the invaluable work in preparation of this manuscript, searching, preliminary cataloging, and typing done by Marion S. Carr, Phyllis M. Martin, Lillie M. Frye, and Beatrice T. Treese. "

HAROLD WOOSTER
Director of Information Sciences
Air Force Office of Scientific Research

Arlington, Va.
June 1970

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1

Aarhus U. Mathematical Inst. (Denmark).

INVESTIGATIONS ON FLUCTUATIONS OF SUMS OF
RANDOM VARIABLES, by E. S. Andersen. Technical
final rept. July 15, 1963, 13p. incl. refs. (AFOSR-
5251) (AF 61(052)42) AD 416361   Unclassified

Investigation has been made of the fluctuations of sums
of random variables X_1, X_2. Previous results have
been generalized on the random variables Hn connected
with this sequence, new results obtained on the validity
of the Arc-sine Law for independent not identically dis-
tributed random variables, a generalization of Spitzer's
identify obtained, and a generalization of the equivalence
principle obtained. Furthermore Toeplitz matrices of
Laurent polynomials have been studied. For the growth
of the maximal order statistics of a sequence of inde-
pendent, identically distributed random variables a
"law of the iterated logarithm" has been obtained.
(Contractor's abstract, modified)

2

Adelphi U., Garden City, N. Y.

A DYNAMICAL MODEL FOR KORDYLEWSKI CLOUD
SATELLITES, by F. V. Pohle. [1964] [3]p. incl.
diagrs. refs. (AFOSR-65-1358) (AF AFOSR-64-598)
                                        Unclassified

Presented at the AIAA Astrodynamics Conf., New
Haven, Conn., Aug. 19-21, 1963.

Also published in AIAA Jour., v. 2: 1818-1820, Oct.
1964.

A dynamical model is presented to explain the pair of
thin cloud-like satellites observed by Kordylewski at
each libration point of the earth-moon system. The
model assumes the existence of a small nucleus at the
stable L point and the existence of dust moving in the
region near the L point. The influence of the moon on
the dust particles can be ignored, and it is hypothesized
that the dust particles are held together in a cloud by
the interacting attractions of the nucleus and earth.

3

AeroChem Research Labs., Inc., Princeton, N. J.

CHEMICAL SCAVENGER PROBE STUDIES OF ATOM
AND EXCITED MOLECULE REACTIVITY IN ACTIVE
NITROGEN FROM A SUPERSONIC STREAM, by A.
Fontijn, D. E. Rosner, and S. C. Kurzius. [1964]
[11]p. incl. diagrs. table, refs. (AFOSR-4625)
(AF 49(638)300)   Unclassified

Also published in Canad. Jour. Chem., v. 42: 2440-
2450, 1964.

A quartz chemical scavenger probe has been developed
to study the local composition of supersonic electrically
discharged gas streams. The probe samples the central
portion of a nonequilibrium jet and allows direct com-

parison with local measurement techniques (e. g., differ-
ential catalytic detectors) for determining active species
concentrations. Active nitrogen from a Mach 3 stream
was sampled and reacted inside the probe with one of
the scavenger gases NO, NH_3, or C_2H_4 at 18.8 mm Hg
and at an average temperature of 500 °K. Limiting
values of the NO destruction rate and the HCN production
rate were observed; however, NH_3 destruction exhibited
no plateau. The observed maximum rate of NO destruc-
tion was 2.1 times as large as the NO flow rate at the
light titration end-point. This difference is attributed
to a reaction of NO, added in excess of the titration end-
point flow, with metastable electronically excited mole-
cules formed within the discharge zone. The converging-
diverging supersonic nozzle-glow discharge source used
in these experiments apparently delivers metastable
excited molecules to the raction zone in a higher relative
concentration than do the more conventional subsonic
electrical discharge flow systems used for most previous
active nitrogen studies. (Contractor's abstract)

4

AeroChem Research Labs., Inc., Princeton, N. J.

CHEMICAL SCAVENGER PROBES IN NONEQUILIBRIUM
GASDYNAMICS, by D. E. Rosner, A. Fontijn, and S.
C. Kurzius. Sept. 25, 1963, 3p. (AFOSR-65-2155)
(AF 49(638)300) AD 629248   Unclassified

Also published in AIAA Jour., 1964.

The scavenger rapidly and quantitatively reacts with
the unstable species in the sampled gas to form one or
more stable products, which can then be analyzed down-
stream by any one of a number of conventional techniques.

5

AeroChem Research Labs., Inc., Princeton, N. J.

CONVECTIVE DIFFUSION AS AN INTRUDER IN
KINETIC STUDIES OF SURFACE CATALYZED RE-
ACTIONS, by D. E. Rosner. [1964] 18p. (AFOSR-64-
1884) (AF 49(638)1138) AD 450107   Unclassified

Also published in AIAA Jour., v. 2: 493-610, 1964.

This paper reviews the current state of knowledge in
this area and outlines chemical kinetic and aerodynamic
applications of available theory as well as areas in
need of further development.

6

AeroChem Research Labs., Inc., Princeton, N. J.

ANALYSIS OF AIR ARC-TUNNEL HEAT-TRANSFER
DATA, by D. E. Rosner. [1964] [4]p. incl. diagr.
refs. (AFOSR-64-2009) (AF 49(638)1138)
                                        Unclassified

Also published in AIAA Jour., v. 2: 945-947, May 1964.

Wethern has compared data on subsonic air arc-tunnel

heat transfer to a water-cooled copper calorimeter with the predictions of several limiting theoretical models and concluded that the assumptions of chemically frozen boundary-layer flow and a noncatalytic wall were virtually exact for most of the conditions studied. Since a copper surface can behave this way at stagnation pressures and enthalpies approaching 1 atm and 10^4 btu/lbm, respectively, calorimeter catalytic activity becomes an important parameter, particularly if effective heats of ablation or total enthalpies are subsequently to be determined from heat-transfer data obtained at thermally significant dissociation levels. In this note, a direct procedure for estimating catalytic activities from such calorimeter heat-transfer data is illustrated, and a prediction is made of the stagnation pressure levels at which gas-phase atom recombination should mask the observed effects of calorimeter surface specificity under arc-tunnel conditions. Implications of this result for materials testing, and factors governing the probability of atom recombination on metal and metal oxide surfaces, are briefly discussed in the light of recent kinetic observations.

7

AeroChem Research Labs., Inc., Princeton, N. J.

KINETIC AND AERODYNAMIC ASPECTS OF THE OXIDATION OF METALS BY PARTIALLY DISSOCIATED OXYGEN, by D. E. Rosner and H. D. Allendorf. Semiannual progress rept. Nov. 15, 1963-May 15, 1964, 24p. (Rept. no. TN-61) (AF 49(638)1195) AD 438927
Unclassified

Using a resistance monitoring technique, the oxidation rate of electrically heated molybdenum and tungsten filaments has been studied over a wide range of oxygen atom concentrations and surface temperatures at flow rates such that the observed oxidation kinetics are not falsified by diffusional limitations. Partially dissociated streams are produced in the pressure range 0.7-10 Torr using a microwave discharge and O-atom concentrations are determined using the NO_2 light titration technique. Under the conditions investigated the oxides of molybdenum and tungsten latilize as rapidly as they are formed and the unprotected metal is subjected to direct attack by oxygen atoms. On molybdenum and tungsten surfaces oxidation probabilities for atomic oxygen are found to be higher than corresponding values for molecular (diatomic) oxygen by up to one to two orders of magnitude, whereas the corresponding activation energies are considerably lower. Moreover, while present studies of the pressure dependence of the rates reveal complex departures from simple 'power-law kinetics' for O_2 attack, the O-atom data reported follow simple-first order kinetics.

8

Aerojet-General Corp., Azusa, Calif.

REACTION OF PENTABORANE AND HYDRAZINE AND THE STRUCTURE OF THE ADDUCT, by H. V. Seklemian, R. W. Lawrence, and G. A. Guter. [1964] [11]p. incl. diagrs. tables. (AFOSR-65-0695) (AF 49(638)1122) AD 615133
Unclassified

Also published in Prog. in Astronaut. and Aeronaut., v. 15: 391-401, 1964.

Pentaborane and hydrazine react in a 1 to 2 molar ratio in dilute cyclohexane solution at a measurable rate by a first order process. The products formed are a white insoluble adduct and one half mol of hydrogen gas per mol of pentaborane used. At low concentrations of reactants, the reaction is first order and zero order reactions. The initial rate is independent of pentaborane concentration and first order with respect to hydrazine. This evidence indicates that there is a soluble intermediate which loses hydrogen by a first order process. At higher concentrations it is believed that the solubility of the intermediate is exceeded and the insoluble portion then decomposed by a first order process. In all the solvents tried which did not react the adduct was found to be insoluble. Thermal decomposition of the adduct did not evolve all of its hydrogen even when heated to 960°C.

9

Aeronautical Research Associates of Princeton, Inc., N. J.

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THREE-DIMENSIONAL VISCOUS VORTEX FLOWS, by C. duP. Donaldson, R. D. Sullivan, and R. S. Snedeker. Final rept. Feb. 1963, 4p. (AFOSR-4619) (AF 49(638)255) AD 407985
Unclassified

The research efforts carried out at ARAP during the past 5 yr in the field of viscous vortex motions are summarized. The work cited constitutes a rather extensive program of theoretical and experimental studies of vortex motions in general and of three-dimensional laminar and turbulent incompressible driven vortices in particular. The theoretical studies fall into 3 general categories: the first and most important comprising velocity distributions for steady laminar motion, the second dealing with unsteady velocity characteristics, and the third treating temperature distributions for the steady motions first considered. An evaluation and discussion of the effects of turbulence in real flows of the general type under consideration is included.

10

Aeronautical Research Associates of Princeton, Inc., N. J.

AN EXPERIMENTAL STUDY OF TURBULENCE IN A DRIVEN VORTEX, by C. duP. Donaldson, and G. G. Williamson. July 1964 [44]p. incl. illus. diagrs. refs. (ARAP technical memo. no. 64-2) (AFOSR-64-1924) (AF 49(638)1187) AD 609460
Unclassified

Measurements have been made at 2 rotational speeds of the mean motion and turbulence levels within a shallow vortex chamber that has a rotating porous wall as an outer boundary. Very nominal levels of turbulence (2 to 3%) were observed on the central plane of these vortices while a significant portion of the mass flow through the vortex was observed to pass through the end wall boundary layers. A fairly high level of turbulence was then introduced into this vortex chamber by means of a grid of axially aligned bars at the outer rim of the

vortex. This high level of turbulence was observed to decay rapidly to a relative level of intensity of about 6%, indicating that for tangential Reynolds numbers up to at least 10^5, the flow with a driven vortex is stable with respect to the introduction of turbulence. The results obtained corroborate Kendall's findings, namely that the primary cause of the degradation of the performance of a confined vortex is the leakage of mass flux through the boundary layers on the end walls of the vortex chamber.

11

Aeronautical Research Associates of Princeton, Inc., N. J.

ENERGY AND MOMENTUM EXCHANGE BETWEEN NONEQUIPARTITION GASES, by T. F. Morse. [1963] [8]p. incl. diagr. table. (AFOSR-64-0119) (AF 49-(638)1224) AD 430661   Unclassified

Also published in Phys. Fluids, v. 6: 1420-1427, Oct. 1963.

The energy and momentum relaxation of a nonequipartition gas mixture is considered. It is assumed that each component of the mixture has a Maxwellian distribution at a temperature T_i, with the peculiar velocity of the Maxwellian measured relative to the mean velocity of the ith species. For the case in which a "diffusion" Mach number is not too large, the results have a particularly simple form. The calculations were carried out for the hard sphere, Coulomb, and Maxwell force laws of interaction. It is also noted how these results may be used to construct kinetic model equations for the case of hard sphere and Coulomb interaction, in a manner similar to that proposed by Sirovich.

12

Aeronautical Research Associates of Princeton, Inc., N. J.

KINETIC MODEL FOR GASES WITH INTERNAL DEGREES OF FREEDOM, by T. F. Morse. [1964] [11]p. (AFOSR-64-0915) (AF 49(638)1224) AD 439868   Unclassified

Also published in Phys. Fluids, v. 7: 159-169, Feb. 1964.

A new model equation has been obtained which permits a kinetic description of gases possessing internal degrees of freedom. The collision term of the model equation is related to the Wang-Chang and Uhlenbeck results for polyatomic gases much in the same manner as the Bhatnagar, Gross, and Krook model is related to the Boltzmann collision integral. A modified perturbation technique utilizing the various time scales of the flow situation has been employed in closing the equations of change. From the model equation and its moments, depending upon the ratio of a flow through time to the inelastic relaxation time, one directly obtains either the bulk viscosity as a term modifying the pressure tensor, or a relaxation equation for the internal temperature. The model also accounts for the contribution to the heat transfer vector due to the presence of internal degrees of freedom. (Contractor's abstract, in part)

13

Aeronautical Research Associates of Princeton, Inc., N. J.

ON THE KINETIC THEORY OF A WEAKLY COUPLED GAS, by G. Sandri. [1964] [2]p. (AFOSR-64-1029) (AF 49(638)1224) AD 440983   Unclassified

Also published in Nuovo Cimento, Series X, v. 31: 1131-1132, Mar. 10, 1964.

The purpose of this note is to cast Bogolubov's original approach in a form that exhibits transparently the convergence difficulties. Consider a spatially homogeneous weakly coupled (classical) gas. The two-particle correlation function, g, is introduced as usual through the definition $g = F^2 - F^1 F^1$. The expansion parameter for the hierarchy of reduced distribution functions is $\epsilon = \sigma_0/kT \ll 1$ with $nr_0^3 = 0 \, (1)$ where σ_0 and r_0 are the depth and range of the two-body (central) potential, U, and n is the mean density of the gas.

14

Aeronautical Research Associates of Princeton, Inc., N. J.

GLOBAL MASTER EQUATION - I, by G. Sandri. [1963] [6]p. (AFOSR-64-1943) (AF 49(638)1224) AD 450325   Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 955-990, May 16, 1964.

A new master equation is derived very directly from the Liouville equation. The validity of the new equation does not depend on the details of the two-body potential and constitutes therefore a considerable generalization of the known results.

15

Aeronautical Research Associates of Princeton, Inc., N. J.

COLLISIONS OF THREE HARD SPHERES, by G. Sandri, R. D. Sullivan, and P. Norem. [1964] [3]p. incl. diagrs. (AFOSR-65-0554) (AF 49(638)1224) AD 614294   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 743-745, Dec. 21, 1964.

The orbits of 3 identical, classical rigid, elastic spheres in otherwise empty flat Euclidean 3-dimensional space have been analyzed. The phase-space domains, Γ_n, that correspond to the occurrence of n successive binary collisions have been determined. The Γ_4 form is precisely stated and illustrated, and the proof that Γ_5 is empty is rigorously described.

16

Aeronautical Research Associates of Princeton, Inc., N. J.

ON THE MOTION WITHIN FLUID GYROSCOPES, by

M. Fiebig. Aug. 1964 [85]p. (ARAP rept. no. 62) (AFOSR-64-1457) (AF 49(638)1262) AD 608703
Unclassified

The flow field which results from the disturbance of an initially laminar, viscous, incompressible sink flow through a cylindrical chamber is investigated. The disturbance considered may arise either from an impulsive motion or a harmonic oscillation of the device perpendicular to its axis of symmetry. The results of this investigation indicate the general behavior of the response of the flow field within such a device over a wide range of the governing parameters. In particular, it is shown that the mean time- or phase-lag of the motion is nearly identical with the inviscid transport time, while the mean amplitude of the response is almost proportional to the inverse distance from the axis when the visco-geometric parameter is smaller than 10^1. Hence, such devices may possibly be used to detect extremely small rates of rotation and may act in a certain sense as excellent gyroscopes. (Contractor's abstract)

17

Aeronutronic, Newport Beach, Calif.

RESEARCH ON NON-EQUILIBRIUM PLASMA PHYSICS, by S. R. Byron and W. W. Lawrence. Final technical rept. Jan. 15, 1963, 14p. incl. table, refs. (Rept. no. U-1985) (AFOSR-4644) (AF 49(638)670) AD 406471
Unclassified

An experimental study of shock waves produced in a T-tube and a theoretical study of electron-ion reaction rates are summarized. Precursor ionization in the T-tube was observed, but no conclusive evidence concerning the source of the ionization was obtained. The study of electron-ion reaction rates resulted in a detailed theory for the rate of three body electron-ion recombination and radiative decay in monatomic gases. Comparison of this theory with published measurements in helium, argon, mercury, and cesium shows very good agreement. (Contractor's abstract)

18

Aeronutronic [Newport Beach, Calif.]

REFLECTION AND SCATTERING OF SOUND BY FLAMES, by H. M. Wight. Nov. 30, 1964, 103p. incl. illus. diagrs. tables, refs. (Rept. no. U-2931) (AFOSR-65-0432) (AF 49(638)1106) AD 612057
Unclassified

This report describes acoustic measurements taken with various laboratory flame systems. These involved (1) determination of the acoustic scatterings and attenuating characteristics of an open premixed propane flame, (2) determination of the attenuation of open solid propellant flames containing varying aluminum concentrations, and (3) determination of the acoustic combustion noise emission characteristics of various solid propellants. The acoustic attenuation, measured with a collimated sound beam propagating through various open gas and solid propellant flames,

was extremely high. The observed attenuation coefficient was at least two orders of magnitude in excess of that attributable either to classical viscous and thermal conductive losses or to molecular relaxation losses. Acoustic scattering measurements indicated intense lateral scattering to be the probable cause of the high attenuation. An acoustic scattering theory was developed in conjunction with a postulated model for a turbulent flame which predicted attenuation coefficients reasonably consonant with the experimental data. The acoustic combustion noise generated by burning small slabs of solid propellant possessed a continuous broadband spectrum of high amplitude. The spectra from a variety of propellants usually peaked at frequencies below 50 cps. Measurable noise was observed above 10 kcps. The noise spectra did not appear to depend on either the ambient pressure level nor on the aluminum content of the propellants.

19

Aerospace Research Associates, Inc., West Covina, Calif.

RESEARCH ON ENERGY ABSORBING STRUCTURES, by D. L. Platus, P. J. Cunningham and others. Final rept. Feb. 1963, 100p. incl. illus. diagrs. (AFOSR-5071) (AF 49(638)1144) AD 402854; AD 415248
Unclassified

Theoretical and experimental studies of convoluted type structures are described. An incremental method for predicting the nonlinear large-deformation behavior of two-dimensional convoluted strips is shown. The method is applicable for elastic as well as plastic stress-strain behavior of the material. The results of the two-dimensional analysis are extended to an analysis of a circumferentially-convoluted cylinder which deforms into a conical shape. Tests on typical two- and three-dimensional convoluted metal specimens are described and correlations of theoretical predictions with experimental results are shown. (Contractor's abstract)

20

Aerospace Research Associates, Inc., West Covina, Calif.

RESEARCH ON ENERGY ABSORBING STRUCTURES. PART II, by D. L. Platus, S. Uchiyama and others. Final rept. Feb. 1964, 63p. incl. illus. diagrs. refs. (AFOSR-64-0154) (AF 49(638)1144) AD 432958
Unclassified

Analytical methods for predicting the large deformation behavior of corrugated cylindrical and conical shell structures are presented, and tests with simple corrugated specimens for evaluating the theoretical predictions are described. Tests on corrugated strips loaded into the plastic range for evaluating previously developed analyses are described, and correlations with theoretical predictions are shown. A novel bimetallic flexural spring damper is described. Moment-curvature tests to demonstrate the behavior are discussed and correlations with theoretical predictions are shown. (Contractor's abstract)

21

Agricultural Research Council. Inst. of Animal
Physiology, London (Gt. Brit.).

THE EFFECTS OF GUANETHIDINE AND MILD EMO-
TIONAL STRESS ON THE NORADRENALINE CONTENT
OF THE HYPOTHALAMUS IN THE CAT AND RAT, by
R. Dagirmanjian and M. Vogt. Apr. 1, 1963 [9]p. incl.
tables, refs. (AFOSR-4850) (AF EOAR-62-19)
AD 413766   Unclassified

Single injections of guanethidine 15 mg/kg i. p. did not
lower the hypothalamic noradrenaline in cats. In con-
trast, daily injections of 15 mg/kg s. c. over a 7 day
period consistently produced a decrease in the hypo-
thalamic noradrenaline. Attempts to lower the hypo-
thalamic noradrenaline in rats after single injections
or daily injections of guanethidine were unsuccessful.
The hypothalamic noradrenaline content of the rat and
cat was not changed by mild emotional stress, such as
barking dogs on cats and immonility or crowding on
rats.

22

Agricultural U., Wageningen (Netherlands) .

PHYSICAL AND CHEMICAL STUDIES OF CHLORO-
PHYLL SYSTEMS, by E. C. Wassink and G. H. M.
Kronenberg. July 1, 1963, 1v. incl. diagrs. refs.
(AFOSR-64-0105) (AF EOAR-62-30) AD 429765
                                                Unclassified

This study is a continuation of work on properties of
pigment-protein complexes in purple bacteria. The
organism under investigation is Chromatium, strain D.
Owing to the fact that the culture obviously contained an
admixture, methods have been investigated for reisolat-
ing Chromatium from the culture. Isolation was
successful by applying high concentrations of diphenyla-
mine (DPA) in the culture medium, in which Chromati-
um appeared to develop much better than the admix-
ture. Experiments performed with the reisolated
Chromatium were compared with those obtained with
other cultures. All listed Chromatium, strain D.

23

Air Force Office of Scientific Research, Arlington, Va.

RECOMMENDATIONS ON RESEARCH IN SEISMOLOGY
FOR THE VELA-UNIFORM PROGRAM OF THE AD-
VANCED RESEARCH PROJECTS AGENCY. Apr. 22,
1963, 24p. (AFOSR-5290) AD 418036 Unclassified

The Advisory Committee for Geophysics of the Air
Force Office of Scientific Research has undertaken to
review the present state of research in support of the
Vela-Uniform program and to make recommendations
on future research. The present programs have been
guided by the 1959 recommendations of the Berkner
panel. This report summarizes the committee's
opinion on progress since 1959 and its recommenda-
tions for research, both basic and applied, needed to
further the objectives of Vela-Uniform. Areas on

which recommendations have been made are: identifica-
tion techniques, data processing arrays, deep-hole and
ocean-bottom detection, magnitude/energy scale, noise
studies, seismicity, source mechanisms - explosions
and earthquakes, crustal studies, theoretical studies,
hypo-center location and level of trained personnel.

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Air Force Office of Scientific Research, Arlington, Va.

CHEMISTRY PROGRAM REVIEW, FISCAL YEAR 1963,
ed. by A. Weissler, M. D. Sprinkel, and O. Rollins.
Dec. 30, 1963, 207p. incl. illus. diagrs. tables, refs.
(AFOSR-64-1003) AD 600623   Unclassified

Contents: Aerospace chemistry, by A. Weissler, New
methods and techniques, by W. L. Ruigh, Inorganic
chemistry, by D. W. Elliott, Chemical reactivity and
mechanisms, by A. J. Matuszko, Symposia, by M. D.
Sprinkel, Chemistry program statistics, by O. W.
Rollins, Reports received in FY 63, by O. W. Rollins,
Current chemistry program, Projects completed in
Fy 1963, Summaries of completed projects, and Chem-
istry as a profession.

25

Air Force Office of Scientific Research, Arlington, Va.

CHEMISTRY PROGRAM REVIEW, FISCAL YEAR 1964,
ed. by A. Weissler, M. D. Sprinkel, and O. W.
Rollins. Nov. 1964, 180p. incl. diagrs. tables, refs.
(AFOSR-64-1872) AD 609875   Unclassified

This report reviews basically the same topics covered
in item no. 24.

26

Air Force Office of Scientific Research, Arlington, Va.

INFORMATION TECHNOLOGY AND THE INFORMA-
TION SCIENCES "WITH FORKS AND HOPE", by
H. Wooster. [1964] [16]p. (AFOSR-64-1897)
AD 608774   Unclassified

Presented at Conf. on Electronic Information Handling,
Pittsburgh, Pa., Oct. 9, 1964.

Electronic information handling is a rapidly developing
technology. It is parasitic upon, host to, and symbiotic
with many other technologies. Like all other technol-
ogies, it is presumably dependent upon a body of funda-
mental scientific disciplines and knowledge. Advances
in information technology can only come in three ways:
by specific R&D efforts in information handling per se;
by exploiting fortuitous advances in ancillary tech-
nologies; and, by improvements in fundamental under-
standing. The emphasis of the paper is on the last of
these, with emphasis on epistemology, intelligent
automata, pattern recognition from visual to semantic,
self-organization, and computer organization and
programming.

27

Air Force Office of Scientific Research, Arlington, Va.

SYMBOLIZATION, TRANSFORMATION AND TRANS-
LATION OF SCIENTIFIC INFORMATION, by H.
Wooster. [1963] [2]p. (AFOSR-64-2003) AD 451189
Unclassified

Also published in Proc. Twenty-sixth annual meeting
of the American Documentation Institute, Chicago, Ill.
(Oct. 6-11, 1963), v. 3: 405-407, Oct. 1963.

In the course of reviewing 23 papers, the author dis-
courses on the personal nature of classification systems,
on thesauruses in general and particular, on choice of
index terms, on documentation centers, on languages
and grammars, and on the use of symbolic logic in
information retrieval.

28

Air Force Office of Scientific Research, Arlington, Va.

THE INFLUENCE OF INERT AND CHEMICALLY
REACTIVE ADDITIVES ON THE MECHANISM OF
DETONATION IN GASEOUS MIXTURES OVER WIDE
RANGES OF INITIAL PRESSURE AND ADDITIVE CON-
CENTRATION, by B. T. Wolfson. 1964, 69p.
(AFOSR-64-2021) AD 450801   Unclassified

Presented at Spring meeting of the Western States
section of the Combustion Institute, Menlo Park, Calif.,
Apr. 27-28, 1964.

This study investigates the effect of He, Ar and CO_2
additives on the mechanism of detonation in stoichio-
metric H-O mixtures over wide ranges of initial pres-
sures and additive concentrations, and attempts to de-
termine the validity of the Chapman-Jouguet thermo-
hydrodynamic theory under these conditions. No
quantitative conclusions can be made about whether
complete chemical and/or thermal equilibrium in the
Chapman-Jouguet plane was established, or to whether
the "frozen" or "equilibrium" product gas sound speed
is most correct in the real gas situation. Additives
retarded the rate of attainment of stable detonation in
stoichiometric H-O mixtures. The stabilization rate
increased with increase in initial pressure and with
decrease in additive concentration. The rates appeared
to be closely associated with the predetonation lengths,
and the deviations between theoretical and experimental
values of detonation parameters.

29

Air Force Office of Scientific Research, Arlington, Va.

CONVERSATION ON INDIAN LIBRARIES, by H.
Wooster. [1964] [5]p. (AFOSR-65-0490) AD 614190
Unclassified

Also published in IASLIC Bull., v. 9: 122-126, Sept.
1964.

This article comments on a number of surface differ-
ences between U. S. and Indian library practices as
noted on a short trip to India. Topics covered include
social status of librarians, use of typewriters, humidity
control, leather bindings, U. S. use of Library of Con-
gress and Dewey Decimal Classification and cards as
contrasted with Indian use of Universal Decimal Classi-
fication, and the cataloging problems thereby created,
and dictionary vs classified catalogs.

30

Air Force Office of Scientific Research, Arlington, Va.

THE R AND D ORGANIZATION'S FUNDAMENTAL
RESEARCH ACTIVITY AS A WINDOW BETWEEN
SCIENCE AND TECHNOLOGY, by W. J. Price.
Apr. 21, 1964, 14p. incl. diagr. (AFOSR-65-0864)
AD 616834   Unclassified

Presented at meeting of the Ninth Inst. on Research
Administration, Washington, D. C., Apr. 20-24, 1964.

The fundamental research activities of an R & D organ-
ization are presented as important both for providing
specific research results in areas of potential pay-off
for the organization and in providing a window between
science and technology. The need and potential for the
latter activity are inherent in the recognition that a
very large portion of the scientific research on which a
given technology depends is always done by other organ-
izations. The discussion deals primarily with the
opportunities and techniques for providing this window.

31

Air Force Office of Scientific Research, Arlington, Va.

A WEB OF WORDS, by H. Wooster. [1963] [43]p.
incl. refs. (AFOSR-67-2809)   Unclassified

Presented at Sixth Annual Institute in Technical and
Industrial Communications, Ft. Collins, Colo.,
July 8-12, 1963.

The author attempts to apply current notions in
linguistics and philosophy to the problems of technical
writing. Major sections are: the frame of reference;
words and word-books; words plus words make sen-
tences; sentences plus sentences make prose. Typical
headings include: Gulliver the gullible, or linguistics
in Lagado; the definer defined; Aristotle was class
conscious; what your dictionary won't tell you; must we
write pidgin?; the mystique of sentencehood; it's art,
but is it pretty?; a sentence is a discrete fragment of a
correlation network of "thoughts" expressed as a
sequential linear array of symbols. The author con-
cludes: "I have found the concepts outlined in this paper
useful in understanding what I, as a conscious entity,
am trying to do when I think and try to express my
thoughts in words. I claim no eternal verities. I make
only the claim of the pragmatist: 'At least for me, some-
times, it works'."

32

Alabama U., University.

SUBMILLIMETER RADIATION FROM RELATIVISTIC
ELECTRONS. Final technical rept. May 3, 1963, 6p.
(AFOSR-4670) (AF AFOSR-61-69) AD 407120
Unclassified

A method for utilization of a bunched relativistic elec-
tron beam for production of such radiation at submilli-
meter wavelengths is reported. In particular, the inter-
action of a bunched beam with the fields propagated by
a corrugated cylindrical waveguide structure is being
investigated. Design criteria for the waveguide struc-
ture have been devised. Cold radio-frequency tests
have been made on structures scaled to C-band, and
the results have been compared with theory. A struc-
ture scaled to 7.5 mm wavelength has been designed
and is being electroformed.

33

Alabama U. [Dept. of Physics] University.

STUDIES OF SOLIDS AT LOW TEMPERATURES.
Final technical rept. Apr. 8, 1963, 23p. incl. diagrs.
(AFOSR-4710) (AF AFOSR-61-43) AD 407671
Unclassified

Radical species which are stable only at low tempera-
tures are investigated by electron spin resonance and
optical methods. The initial compound chosen for study
was KH_2PO_4, the deuterated compound also being in-
cluded in this investigation. 50-kv x-rays produce
free radicals in this compound which appear to be com-
pletely stable at liquid air temperatures, but decay
rapidly above about 140°K. Complete orientation data
were taken on this compound about all three crystal-
lographic axes for both undeuterated and deuterated
crystals.

34

Alabama U. Dept. of Physics, University.

TEMPERATURE DEPENDENCE OF THE PURE
QUADRUPOLE FREQUENCY AND SPIN-LATTICE RE-
LAXATION TIME OF p-DIBROMOBENZENE, by R. F.
Tipsword, E. L. Wilkinson, and W. G. Moulton.
[1964] [3]p. incl. diagrs. table. (AFOSR-65-0180)
(AF AFOSR-63-288) AD 456566   Unclassified

Also published in Jour. Chem. Phys., v. 41: 2854-
2856, Nov. 1, 1964.

The dependence of the Br^{79} and Br^{81} pure quadrupole
resonance frequencies on temperature in p-dibromo-
benzene were measured over the temperature range
4.2° to 77°K. The results are compared with the
Bayer theory, using values for the torsional fre-
quencies obtained from the Raman data for p-dibromo-
benzene. Good agreement with the theory is obtained
if both the low-frequency and high-frequency modes
are included in the calculation. The spin-lattice relax-
ation time of the resonance were measured in the range
4.2° to 7.5°K and the relaxation time was found to be
proportional to T^9 in this limited temperature region.
The experimental results are compared with the Bayer
theory.

35

Alpha Research Inc., Santa Barbara, Calif.

THE DYNAMICS AND AERODYNAMICS OF SELF-
SUSTAINED LARGE ANGLE OF ATTACK BODY
SPINNING MOTIONS, by J. E. Brunk. Final rept.
Feb. 1963, 1v. incl. diagrs. tables, refs. (Rept. no.
63-1158-1) (AF 49(638)1158) AD 407183
Unclassified

Several aerodynamic mechanisms, which will sustain
large angle of attack body autorotative motions, are
examined. It is shown that autorotative motion can
result in a very large drag force, which may signifi-
cantly aid missile and booster recovery. A linear
theory, which satisfactorily predicts the near-steady-
state autorotative spin characteristics of quasi-axi-
symmetric bodies, is presented. The initiation of body
autorotative motions under both low altitude and re-
entry environments is investigated by a special six-
degrees-of-freedom trajectory program. The aero-
dynamic characteristics of cylinder-shaped bodies at
angles of attack near 90 degrees are discussed.

36

American Mathematical Soc., Providence, R. I.

SUMMER SEMINAR IN SPACE MATHEMATICS, by J.
B. Rosser. Final rept. July 1-Aug. 9, 1963, 33p.
(AFOSR-64-0723) (AF AFOSR-63-258) AD 612385
Unclassified

The Summer Seminar in Space Mathematics was a joint
undertaking of the American Mathematical Society and
the Yale Dynamical Astronomy Institute. Thus, it
combined the third Summer Seminar in applied mathe-
matics with the fifth consecutive Dynamical Astronomy
Institute. The purpose of the Seminar was to provide
instruction, stimulation and cross-fertilization in the
subjects of dynamical astronomy, mathematics and the
physics of high speed flight. Mathematicians and
astronomers heard from leading advanced mathemati-
cians, astronomers and applied physicists on topics
which cut across the disciplines contributing to space
science. The first two weeks were mainly devoted to
basic courses which provided background material in
practical astronomy, elliptic orbits, basic fluid dy-
namics, variational calculus and the method of steepest
descent, dynamic programming, and the computer work-
shop In the second two weeks, in addition to basic
courses in Lagrange-Hamiltonian-Jacobi mechanics
and computation procedures for differential equations,
special topics of interest in space activity were
stressed; included were artificial satellite theory,
orbit decay, the Earth-Moon system, gas flow models,
shock waves in very rare gases, and heat flow with
receding boundaries. The final two weeks included a
great variety of advanced and specialized topics of
current interest in the space sciences.

37

American Soc. of Mechanical Engineers, New York.

APPLIED MECHANICS REVIEWS; WADEX WORD
AND AUTHOR INDEX, VOLUME 16, 1963, by E. A.
Kipperger, H. Wooster and others. 1963, 627p.
(AFOSR-65-0728) (AF AFOSR-64-33) AD 621209
Unclassified

This second WADEX is based on 8,000 titles of
Applied Mechanics Reviews (AMR), Vol. 16, 1963, an
international critical review magazine. In WADEX,
titles are printed fully with author names, and as many
lines used as necessary (60 characters per line).
WADEX entry: word in title (except forbidden word) or
author's name. Alphabetically sequenced entries are
printed out of context. Words are single words or
hyphenated word pairs or "Tagged Words" (TW). The
latter consist of significant "word compounds" in which
one or more words are forbidden words. TW are
selected from the subject index authority list of AMR
and hyphenated words, from frequency list of words of
previous WADEX. For more than one identical word
entries, titles are alphabetized according to first
author and for more than one identical author entries
are by reference number, which is printed in line with
the entry. Each entry is followed by block containing
year/month/AMR review number. Multiple entries
are listed only once per column. WADEX is arranged
in 2 columns, both columns printed simultaneously
with dictionary entries at top and pagination at bottom
by computer. After addition of 26 alphabetics,
"Compuscript" is the photo-ready copy with 6.5 aver-
age entry per paper including 1.5 for authors.

38

American Soc. of Zoologists, Chicago, Ill.

LEARNING AND ASSOCIATED PHENOMENA IN
INVERTEBRATES: PROCEEDINGS OF A CONFERENCE,
Cambridge (Gt. Brit.) (July 7-9, 1964), ed. by W. H.
Thorpe and D. Davenport. London, Baillière, Tindall
& Cassell, Ltd. [1964] 190p. incl. illus. diagrs.
tables, refs. (Animal Behaviour Suppl. no. 1)
(AFOSR-65-1685) (MIPR-84-3) Unclassified

Twenty papers on learning and associated phenomena
in invertebrates are contained in this work. These
papers are (1) Learning, World Models and Preadapta-
tion; (2) Paramecia, Planaria and Pseudo-learning;
(3) Studies of the Behaviour of Paramecium aurelia;
(4) Behavioural Studies of the Coelenterate Hydrapiradi;
(5) The Behaviour of Sessile Coelenterates in Relation
to Some Conditioning Experiments; (6) Adaptive Changes
in Cnidarians; (7) Cannibals, Chemicals and Contiguity;
(8) Behaviour of Planaria in Instrumental Learning
Paradigms; (9) Learning in Planarians: Current
Status; (10) Learning in Annelids and Attempts at the
Chemical Modification of this Behaviour; (11) The
Learning Abilities of Nereid Polychaetes and the
Role of the Supra-oesophageal Ganglion; (12) Research
and Theory on Conditioning of Annelids; (13) Descartes,
Mechanistic Biology and Animal Behaviour; (14) Re-
port of a Special Discussion on Planarian Learning;
(15) Learning and Movement in Octopuses; (16) Dis-

crimination Learning in the Octopus; (17) Release and
Orientation of Behaviour and the Role of Learning as
Demonstrated in Crustacea; (18) Aspects of Orientation
in the Diggerwasp Bembix Rostrata; (19) The Electro-
physiological Approach to Learning in Isolatable
Ganglia; and (2) Macromolecular Coding in Nerve Cell
and Embryo.

39

Amoco Chemicals Corp., Seymour, Ind.

THE STUDY OF BORON PERCHLORATE AND RE-
LATED SYSTEMS, by R. A. Mosher, E. K. Ives, and
E. F. Morello. Final rept. Oct. 1, 1961-Sept. 30,
1964, 23p. incl. tables, refs. (AFOSR-65-1055)
(AF 49(638)1105) AD 617941 Unclassified

The compounds BCl_2ClO_4, $BCl(ClO_4)_2$ and $B(ClO_4)_3$
have been prepared by the reactions between BCl_3 and
anhydrous $HClO_4$. They are extremely sensitive to
moisture undergoing rapid hydrolysis even at -78°C.
The compounds are also thermally unstable, where
BCl_2ClO_4 decomposes with evolution of chlorine,
$BCl(ClO_4)_2$ with evolution of chlorine and chlorine
heptoxide and $B(ClO_4)_3$ with evolution of chlorine heptox-
ide. All 3 compounds on decomposition give a residue
which contains B, O, and ClO_4. The chloroperchlorates
also undergo disproportionation reactions by loss of
BCl_3, especially under vacuum treatment. Density,
refractive index, molecular weight and surface tension
have been determined for the boron chloroperchlorates.
Molar refractivity and the parachor were calculated for
the chloroperchlorates and both give values which agree
closely with values for the postulated compounds. Heat
of hydrolysis was determined calorimetrically for
BCl_2ClO_4 and from this, a value for the heat of forma-
tion was derived which agrees closely with a calculated
value. The chloroperchlorates give solid adducts with
$(CH_3)_3N$, the stability decreasing from BCl_2ClO_4 to
$BCl(ClO_4)_2$. The triperchlorate did not form an adduct
with trimethylamine but did form a somewhat stable
adduct with nitronium perchlorate. The reaction of
some non-metal halides and anhydrous HClO were
investigated briefly. The results are presented.

40

Antioch Coll. Behavior Research Lab., Yellow Springs,
Ohio.

VIGILANCE: A REVIEW AND RE-EVALUATION, by
H. J. Jerison and R. M. Pickett. [1963] [28]p. incl.
diagrs. table, refs. (AFOSR-64-0840) (AF AFOSR-
63-150) AD 438394 Unclassified

Also published in Human Factors, v. 5: 211-238, June
1963.

Vigilance as a human factors area is concerned with
the fact that man is much less capable as a detector of
signals under operational conditions than would be indi-
cated by laboratory measures of his sensory thresholds.
The area, which is obviously important for the analysis
of man's visual capabilities in the operation of manned

space systems, is re-examined with the help of a theoretical model that introduces a decision-theory approach to the observing response phase of the vigilance task. After a critical review of the vigilance literature, examples are presented of the application of this approach to the solution of human factors problems of the sort that might arise in manned space missions. The model is also used to suggest the kind of research that would make it easier to predict field monitoring performance from laboratory experiments. (Contractor's abstract)

41

Arizona State U. [Dept. of Physics] Tempe.

OXYGEN VACANCIES AND ELECTRICAL CONDUCTION IN METAL OXIDES, by C. J. Kevane. [1964] [6]p. (AFOSR-64-1230) (AF AFOSR-62-130) AD 442809   Unclassified

Also published in Phys. Rev., v. 133: A1431-A1436, Mar. 2, 1964.

Oxygen vacancies and their effects on electrical conduction in some metal oxides were considered through an exact solution of the equilibrium relations between oxygen partial pressure in the ambient gas and concentrations of oxygen vacancies and conduction electrons in the oxide. The mass-action law was assumed but no state of ionization of oxygen vacancies was neglected. Concentrations of electrons in conduction states and total oxygen vacancies were considered. The results, which possess considerable complexity not contained in the usual limiting-case solutions, were compared with pertinent experiments.

42

Arizona U., Tucson.

DOCUMENT SELECTION METHODS — A GENERAL ANALYSIS, by J. W. Perry. [1963] [64]p. incl. diagr. refs. (AFOSR-64-0562) (AF AFOSR-62-289) AD 434403   Unclassified

Also published in Readings in Special Librarianship, ed. by H. S. Sharp. New York, Scarecrow Press, 1963, p. 507-573.

This paper shows how traditional indexing and classifying methods relate to such recently developed techniques as uniterm, computer searching, and the like. First discussing the 'information explosion' as the natural consequence of increased emphasis on research and development during the past few decades, it then analyzes the performance and requirements of workable deep-indexing information retrieval systems. Emphasis is on the application of logic to specify the selection of pertinent documents from a universe of pertinent and nonpertinent documents rather than on the hardware which is employed in such selection. (Contractor's abstract)

43

Arizona U., Tucson.

PROBLEMS OF TRANSFERENCE OF MEANING IN AUTOMATED TECHNIQUES, by J. W. Perry. [1964] [19]p. incl. diagr. table, refs. (AFOSR-65-1169) (AF AFOSR-62-289) AD 621354   Unclassified

Also published in Proc. Inst. Tech. and Indus. Commun., Colorado State U., Fort Collins, Colo., July 6-10, 1964, p. 96-114.

Applications of automated techniques to facilitate transference of meaning present widely different problems which can be characterized in terms of various barriers to communication, i.e., culture, symbols, space, and time. Two questions are presented: (1) How can logically defined automation techniques be applied to advantage in dealing with communication problems whose logical analysis remains only partial?; and (2) How shall we conduct the analysis of communication problems so that the results may provide the most effective possible guidance in planning and applying automation technique? Pragmatic answers to these questions are sought through discussion of the four communication barriers.

44

Arizona U., Tucson.

ANALOG/HYBRID STORAGE AND PULSE MODULATION, by G. A. Korn. [1963] [2]p. incl. refs. (AFOSR-5178) (AF AFOSR-63-89) AD 416389
          Unclassified

Also published in IEEE Trans. Electron. Comput., EC-12: 411-412, Aug. 1963.

The advent of new very fast, digitally controlled analog computers poses the requirement of storing and reproducing samples of analog functions $f(t)$ of length TR, where TR is the duration of one iterative-computer run (T = 1 msec to 100 msec). While function storage for the duration of a single computer run is already useful for many iterative computation schemes, such as the solution of integral equations, function storage for an indefinite time period would be substantially more desirable and would, for instance, permit table lookup and storage of functions for use in later computation cycles.

45

Arizona U., Tucson.

HYBRID ANALOG-DIGITAL RANDOM-NOISE GENERATION, by R. Hampton, G. A. Korn, and B. Mitchell. [1963] [3]p. (ACL memo. no. 71) (AFOSR-5179) (AF AFOSR-63-89) AD 416387   Unclassified

Also published in IEEE Trans. Electron. Comput., Aug. 1963.

Random noise generators for random-process and statistical studies with analog and hybrid analog-digital computers should produce noise signals whose amplitude distribution, d-c unbalance, spectrum, and RMS level is specified within the computer-accuracy limits (0.1 to 0.5%). In addition, the noise must be free from periodic components; noise samples must be uncorrelated for delays exceeding, say, one-thousandth to one-ten-thousandth of a typical computer run.

46

Arizona U., Tucson.

A MASTER CONTROL CLOCK SYSTEM FOR A HYBRID DIFFERENTIAL ANALYZER, by R. L. Maybach, E. P. O'Grady, and J. V. Wait. May 1963, 13p. (ACL memo. no. 81) (AFOSR-5181) (AF AFOSR-63-89) AD 414456   Unclassified

The control clock system which was developed as part of the hybrid differential analyzer project is discussed. In this system, machine computation proceeds in alternate analog and digital computing intervals. The precise generation of these time intervals, and the command of the solution read-out time are the principal functions of the clock system.

47

Arizona U., Tucson.

HYBRID COMPUTING SYSTEMS AND COMPONENTS, by G. A. Korn, J. V. Wait and others. Aug. 1963, 124p. (AFOSR-5235) (AF AFOSR-63-89) AD 630198
                                    Unclassified

This report contains 1962 Progress and ASTRAC II project, by G. A. Korn. A solid-state analog comparator for hybrid analog-digital comparators, by J. V. Wait and R. L. T. Hampton. A simple solid-state digital-to-analog converter for hybrid computing systems, by J. V. Wait and B. A. Mitchell. An interpolation waveform generator for use in hybrid computing systems, by J. V. Wait. Analog-hybrid storage and pulse modulation. A hybrid/analog-digital one-parameter optimizer, by B. A. Mitchell. Hybrid analog-digital random-noise generation, by R. Hampton, G. A. Korn, and B. Mitchell. A nonsaturating transistor switch for analog/hybrid instrumentation and computers, by T. A. Brubaker. Simple integrator-input addition of hybrid variables, by E. P. O'Grady and J. V. Wait.

48

Arizona U., Tucson.

A HYBRID ANALOG-DIGITAL DIFFERENTIAL ANALYZER SYSTEM, by J. V. Wait. June 1963, 141p. (ACL memo no. 76) (AFOSR-5236) (AF AFOSR-63-89) AD 479647   Unclassified

A true hybrid (parallel analog-digital) differential analyzer, by combining many of the advantages of both analog and digital systems, may be useful in applications where moderately high-accuracy real-time and faster-than-real-time computing is required. This thesis covers the results of theoretical and experimental studies of a hybrid computing system. A hybrid system gains accuracy through the use of digital techniques; analog (continuous) interpolation frees the hybrid system of truncation and round-off errors. The system also preserves most of the ease-of-programming features associated with analog computers. These features permit a hybrid differential analyzer using only a few digital bits and a moderate digital clock rate, to achieve both an accuracy and a bandwidth or speed-of-operation comparable to modern high-speed digital differential analyzers.

49

Arizona U., Tucson.

A DELTA-SIGMA MODULATION SYSTEM FOR TIME DELAY AND ANALOG FUNCTION STORAGE, by H. Handler and R. H. Mangels. Jan. 1964, 41p. (AFOSR-64-0392) (AF AFOSR-64-89) AD 434539
                                    Unclassified

Modified delta modulation (delta sigma modulation) permits magnetostrictive delay line function storage of analog data with the significant advantages of pulse regeneration with clock gated logic and relatively inexpensive conversion equipment. Five to 10 msec delay lines with a 2 mc bit-rate accommodate analog signals of up to 8 kc with phase shift below 2 degrees; total dynamic error is within 0.2% of half scale up to 1 kc. An adaptive filter permits a further trade off of accuracy for bandwidth during computation. This paper describes the design of the delta-sigma modulation systems and presents test results.

50

Arizona U., Tucson.

A HYBRID ANALOG-DIGITAL PSEUDO-RANDOM NOISE GENERATOR, by R. L. T. Hampton. Jan. 1964, 45p. (AFOSR-64-0393) (AF AFOSR-64-89) AD 434556   Unclassified

The design of a hybrid analog-digital pseudo-random noise generator intended to replace conventional random-noise generators in analog and hybrid computer simulating is described. It is capable of producing four essentially uncorrelated binary outputs from a single 25-stage shiftregister. The length of the pseudo-random output sequence is 33, 554, 431 bits which is equivalent to several thousand computer runs.

51

Arizona U. Dept. of Physics, Tucson.

IMPERFECTIONS IN METALS, by C. T. Tomizuka. Final rept. Jan. 1, 1960-Dec. 31, 1962. Jan. 1, 1963, 13p. (AFOSR-4642) (AF 49(638)790) AD 408483
                                    Unclassified

The progress of research conducted under this contract is summarized. This research is either under way or is now completed and includes (1) diffusion experiments in pure noble metals under hydrostatic pressure, (2) diffusion experiments as a function of temperature to obtain the activation energy, (3) internal friction measurements in α-brass type alloys, (4) tracer diffusion experiments in alloys, and (5) resistivity increase of quenched-in wires of noble metals under hydrostatic pressure to obtain the activation volume of a vacancy.

52

Arkansas U. Dept. of Chemistry, Fayetteville.

ELECTRODE POTENTIALS IN FUSED SYSTEMS. VIII. OXIDATION KINETICS OF SILVER IN SODIUM CHLORIDE, by K. H. Stern and W. E. Reid, Jr. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0369) (AF 49(638)653) AD 611923   Unclassified

Also published in Jour. Phys. Chem., v. 68: 3757-3764, Dec. 1964.

The oxidation rate of metallic silver in molten sodium chloride has been studied as a function of oxygen partial pressure and temperature (800-900°). The rate of appearance of silver ions was followed by an e.m.f. method. These ions are formed by: (A) the reaction of O_2 with silver and (B) the reaction $Ag + Na^+ = Ag^+ + Na$. The rate of (A) is a linear function of p_{O_2} in the range $0 < p_{O_2} \leq 1$ atm. For $p_{O_2} = 1$ at 870°, $r_A = 11.9 \times 10^{15}$, $r_B = 0.35 \times 10^{15}$ atoms cm^{-2} sec^{-1}. With increasing time $d[Ag^+]/dt$ decreases because of the reverse of reaction A—the formation of metallic silver from Ag^+ and O^{-2} ions—for which $r_A^{-1} = (r_A + r_B)/K_A p_{O_2}^{1/2}$, where K_A, the equilibrium constant for (A), is 8.3×10^{-7} on the mol fraction scale. The general differential equation for this system is derived and numerically integrated. It is concluded that the rate-determining step for (A) is the chemisorption of O_2, which is hindered by an adsorbed layer of chloride ions, and that for (B) charge transfer is rate-determining.

53

Arkansas U. Dept. of Physics, Fayetteville.

EXCITATION OF THE 2p LEVEL IN LITHIUM BY ELECTRON IMPACT, by R. H. Hughes and C. G. Hendrickson. [1964] [1]p. incl. diagr. table. (AFOSR-65-2880) (AF AFOSR-62-159) AD 628427
Unclassified

Also published in Jour. Opt. Soc. Amer., v. 54: 1494, Dec. 1964.

The excitation function for the 2p to 2s (wavelength = 6708A) line in the first spectrum of lithium was obtained by observing this radiation from the interaction region formed by a lithium-atom beam and a crossed electron beam.

54

Atlantic Research Corp., Alexandria, Va.

RESEARCH ON HIGH PRESSURE PLASMA PRODUCTION TECHNIQUES, by R. Friedman, L. W. Fagg and others. Final technical rept. Feb. 1964, 1v. (AFOSR-64-1291) (AF 49(638)651) AD 443153
Unclassified

The sections of this report are entitled: Historical Summary; Basis of Thermodynamic Calculations Performed; Solid propellant source of cesium plasma; Study of electron generation by solid propellant techniques; A novel chemical system for generation of electron-rich gases; and Spectrographic study of chemically generated cesium plasmas.

55

Atlantic Research Corp., Alexandria, Va.

THE KINETICS OF THE THERMAL, HYDROGEN-FLUORINE REACTION. I. MAGNESIUM REACTOR, by J. B. Levy and B. K. W. Copeland. [1963] [4]p. (AFOSR-64-0124) (AF 49(638)1131) AD 430673
Unclassified

Also published in Jour. Phys. Chem., v. 67: 2156-2159, 1963.

The kinetics of the reaction of hydrogen and fluorine in gaseous mixtures diluted with nitrogen have been studied in a flow system at 110 in magnesium reaction vessels. The effects of reactant concentrations and surface area-to-volume ratio have been examined. Some possible reaction mechanisms are discussed.

56

Austrian Atomic Energy Study Group. Dept. of Physics, Seibersdorf.

[A ROTATING CRYSTAL SPECTROMETER WITH A MECHANICAL PRESELECTOR OF NEUTRON ENERGIES] Ein rotierendes Kristallspektrometer mit mechanischem Vorselektor der Neutronenenergie, by G. Quittner and C. Schittenhelm. [1963] [5]p. incl. diagrs. (AFOSR-J1100) (AF 61(052)638) AD 421750
Unclassified

Also published in Atompraxis . 9: 281-285, July 1963.

A rotating crystal spectrometer for inelastic scattering of thermal neutrons is described. A low energy of incoming neutrons, which is advantageous from the point of view of resolution, requires some means for removing higher-order neutrons. This is achieved by a mechanical rotor preselector; some data concerning it are given in the second part of the paper.

57

Austrian Atomic Energy Study Group. Dept. of Physics, Seibersdorf.

INTENSITY, BACKGROUND AND RESOLUTION WIDTH IN NUCLEAR COUNTING EXPERIMENTS, by G. Quittner. [1964] [7]p. incl. diagrs. (AFOSR-65-1371) (AF 61(052)638) AD 622670   Unclassified

Also published in Nuclear Instr. and Methods, v. 31: 61-67, 1964.

Some formulas ars developed for the evaluation of nuclear counting experiments with regard to their statistical accuracy. Three types of measurements are considered: (1) simple counting, (2) location measurements, and (3) intensity distribution measurements. Finally, the relation of the statistical uncertainty to other sources of error is discussed briefly, leading to the matching principle. Examples are drawn mainly from the field of inelastic scattering of thermal neutrons.

58

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

CURRENT SPEED IN A MAGNETIC ANNULAR SHOCK TUBE, by J. Keck. May 1963, 32p. incl. illus. diagrs. refs. (Research rept. no. 152) (AFOSR-4910) (AF 49(638)659) AD 407294   Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 3, Oct./Dec. 1963.

A parametric study of the speeds of the current sheet and center-of-gravity of current in a magnetic annular shock tube has been completed. The parameters varied include: (1) the drive current, (2) the polarity of the inner electrodes, (3) the gas pressure, (4) the nature of the gas, (5) the radius of the inner electrode, and (6) the material of the inner electrode. The most interesting result of the investigation was the observation of limiting speeds for the current sheet and center-of-gravity of current of approximately 8 cm/mus and 3 cm/mus, respectively. These speeds were not exceeded even under conditions where the magnetic pressure exceeded the dynamic pressure by a factor of 10. The most probable explanation of the limiting speed is that it is due to the inertial drag of material ablated from the insulator at the driver end of the shock tube.

59

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

MHD CHARACTERISTICS AND SHOCK WAVES, by A. R. Kantrowitz and H. E. Petschek. July 1964, 58p. incl. diagrs. refs. (Research rept. no. 185) (AF 49-(638)659) AD 603951   Unclassified

A review of the theory of MHD characteristics and shock waves is presented. Primary emphasis is placed on a physical discussion of the three characteristic modes and the jump conditions for the two types of shock

waves which can exist. Brief discussions of shock structure, applications of the theory, and the range of applicability of the continuum equations are also given. (Contractor's abstract)

60

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

USE OF GUARD RING SHIELDS ON NEGATIVELY BIASED LANGMUIR ION COLLECTION CURRENT PROBES, by G. S. Janes and J. P. Dotson. Apr. 1964, 6p. (AF 49(638)659) AD 600473   Unclassified

The note describes a shielded ion collection probe that provides a constant effective ion collection area. It is particularly useful when the plasma properties vary in time or space.

61

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

BASIC STUDIES IN MAGNETOHYDRODYNAMICS, by R. M. Patrick. Final rept. Nov. 1964, 10p. incl. diagrs. refs. (AFOSR-65-1207) (AF 49(638)1129) AD 622701   Unclassified

In this investigation, the magnetic annular shock tube (MAST) is developed and used to study plasma phenomena important for collision free plasmas. Studies are carried out to bring the MAST to a state of development where it will become an established research tool. It is found that for a given shock velocity the shock tube must have a minimum length and that the plasma must be contained away from the walls of the tube, this being done by the use of magnetic fields. The annulus ratio and ablation are also important considerations in successful MAST operation. The plasma produced by the shock wave is collisionless in that the mean free path for ordinary collisions is large compared to the shock thickness. However, the importance of collisions in the shock front itself is not clear.

62

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

MAGNETOHYDRODYNAMIC SHOCK STRUCTURE IN A PARTIALLY IONIZED GAS, by E. T. Gerry, R. M. Patrick, and H. E. Petschek. June 1963, 19p. (Research rept. no. 153) (AF 49(638)1129) AD 414622   Unclassified

A study has been made of strong MHD shock waves in partially ionized hydrogen. Dissipation due to slip between the ions and neutrals with the effects of viscosity and heat conductivity have been included. Charge exchange processes control viscosity and ion slip. For Alfven Mach numbers below 2.5, the dominant mechanism is ion slip; for larger Mach numbers, the viscosity is important. The measured light intensity rise time and the electron temperature immediately behind the shock agree with theory. Behind the shock, measured electron temperatures are low. Electron temperatures

are obtained by measuring the plasma soft x-radiation using thin carbon foils as filters. (Contractor's abstract)

times behind the reflected shock, and these are in agreement with an extrapolation of the Petschek and Byron measurements behind the incident shock.

63

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

THERMAL CONDUCTIVITY OF ARGON AT HIGH TEMPERATURES, by M. Camac and R. M. Feinberg. Mar. 1963, 50p. (Research rept. no. 168) (AF 49-(638)1129) AD 429757   Unclassified

The infrared heat transfer gauge was used for end wall measurements of the convective heat transfer from argon behind the reflected shock. The thermal conductivity of neutral (unionized) argon was measured before the ionization relaxation time, and could be fit with the temperature dependence T $(0.76 \pm .03)$ over the free stream temperature range from 20,000°K to 75,000°K, corresponding to incident shock velocities from 3 to 6 mm/micro-sec. At later times, after the free stream established equilibrium ionization, the convective heat transfer rate remained the same as the initial neutral argon rate. Theoretical predictions of Fay and Kemp, assuming equilibrium boundary layer conditions, are 20 to 30% below the experimental values. Also reported in this paper are measurements of the ionization

64

Avco Corp. Research and Advanced Development Div., Wilmington, Mass.

EMITTANCE MEASUREMENTS OF SOLIDS ABOVE 2000 DEG C, by T. S. Laszlo, R. E. Gannon, and P. J. Sheehan. [1964] [7]p. incl. illus. diagrs. refs. (AFOSR-65-0164) (AF 49(638)1166) AD 611945
                                            Unclassified

Presented at Symposium on Thermal Radiation of Solids, San Francisco, Calif., Mar. 4-6, 1964.

Also published in Solar Energy, v. 8: 105-111, Oct.-Dec. 1964.

A method of measuring the emittance of solids above 2000°C through the use of a solar furnace has been developed. Two techniques involving specialized instrumentation for performing the necessary measurements were investigated. Initial experiments showed that both techniques were suitable and that the specified instruments were adaptable for making the required measurements. (Contractor's abstract)

65

Battelle Memorial Inst., Columbus, Ohio.

HIGH-PRESSURE SYNTHESIS OF MOLYBDATES
WITH THE WOLFRAMITE STRUCTURE, by A. P.
Young and C. M. Schwartz. [1963] 2p. (AFOSR-
J1607) (AF 49(638)441) AD 427643   Unclassified

Also published in Science, v. 141: 348-349, July 26,
1963.

A series of small cation molybdates, with the wolfra-
mite structure characteristic of the corresponding
tungstates have been synthesized at high pressure and
temperature. The high-pressure compounds revert to
the ambient pressure modifications if heated in air at
600°C. (Contractor's abstract)

66

Battelle Memorial Inst., Columbus, Ohio.

ON THE HIGH-PRESSURE FORM OF $FeVO_4$, by F.
Laves, A. P. Young, and C. M. Schwartz. [1964]
[2]p. incl. table. (AFOSR-65-0766) (AF 49(638)441)
AD 617211   Unclassified

Also published in Acta Cryst., v. 17: 1476-1477, Nov.
1964.

In this note evidence is presented that the atomic ar-
rangement of high-pressure $FeVO_4$ is similar to that of
ambient-pressure $FeNbO_4$. Evidence is presented in
the form of comparing the indexing of high-pressure
$FeVO_4$ and the disordered wolframite $FeNbO_4$, which
indicates that $FeVO_4$ crystallizes in the disordered
wolframite type and that therefore vanadium would have
also in $FeVO_4$ the coordination number 6. The similar
structure of the two compounds offers an example of a
high-pressure oxide with the same type of structure as
an ambient-pressure oxide.

67

Battelle Memorial Inst., Columbus, Ohio.

THE ORIGIN OF DISLOCATIONS DURING CRYSTAL
GROWTH, by N. Albon. [1963] 7p. incl. diagr. refs.
(AFOSR-J1137) (AF 49(638)959) AD 421166
                    Unclassified

Also published in Philos. Mag., v. 8: 1335-1341, Aug.
1963.

A mechanism is described requiring contact between
stepped crystal faces which can lead to the formation
of dislocations during crystal growth. The initiation
of dislocations during both nucleation and growth is
explained. Conditions under which the proposed
mechanism and others previously suggested are sig-
nificant are discussed qualitatively in relation to rele-
vant experimental observations. (Contractor's
abstract)

68

Battelle Memorial Inst., Columbus, Ohio.

INVESTIGATION OF ZINC BLENDE TYPE SEMI-
CONDUCTORS, by A. C. Beer. Oct. 25, 1963, 19p.
(AFOSR-J1352) (AF 49(638)959) AD 428335
                    Unclassified

The accomplishments are presented under 3 broad
categories, namely: (1) Research concerned with InSb,
which involves transport effects, high pressure phase
transitions, and studies of the kinetics of crystal
growth and related phenomena; (2) Studies of impurity
behavior in GaSb, which have shed light on the nature
of the residual acceptors present in material prepared
under conditions conducive to achievement of highest
purity; and (3) Transport studies in GaSb, which have
revealed the importance of impurity states associated
with subsidiary conduction band minima. Implications
of the findings in these areas are discussed, and sug-
gestions for further work are given in certain instances.
(Contractor's abstract)

69

Battelle Memorial Inst., Columbus, Ohio.

DIFFUSION IN SOLIDS, by A. E. Austin and F. J.
Milford. Final rept. July 1, 1961 - Dec. 31, 1962.
Jan. 17, 1963, 3p. (AFOSR-4401) (AF AFOSR-61-
107) AD 295930   Unclassified

Previous investigations studied the diffusion of nickel
into copper bicrystals, while the present experiments
have been concerned with the diffusion of gold into
copper bicrystals. The theoretical solutions and ap-
proximations were evaluated mathematically and the
results used for the analysis of the experimental data.
The case of surface diffusion in metal systems is com-
parable to that of grain-boundary diffusion in that
both involve concomitant volume diffusion. Therefore
experimental and theoretical studies of surface diffu-
sion were initiated as an extension of those on grain-
boundary diffusion. (Contractor's abstract)

70

Battelle Memorial Inst., Columbus, Ohio.

NOTE ON THE EVALUATION OF SOME FERMI IN-
TEGRALS, by M. L. Glasser. [1964] 3p. (AFOSR-
64-2347) (AF AFOSR-63-260) AD 452291
                    Unclassified

Also published in Jour. Math. Phys., v. 5: 1150-1152,
Aug. 1964.

Integrals of the form which involves the Fermi energy
are frequently encountered in the study of thermal and
magnetic properties of metals. A standard method for
estimating these integrals is to make the change of the
variable and replace the lower limit of the transformed
integral by negative infinity. The integration can then
be performed by closing the contour in the upper half-
plane. In this note a method is outlined by which

asymptotic expansions can be obtained if the given function involves roots or logarithms of E and the integrals evaluated explicitly if this is not the case. The procedure is illustrated for several integrals selected from the literature.

71

Battelle Memorial Inst., Columbus, Ohio.

SUMMATION OVER FEYNMAN HISTORIES: CHARGED PARTICLE IN A UNIFORM MAGNETIC FIELD, by M. L. Glasser. [1964] 4p. (AFOSR-64-1781) (AF AFOSR-63-262) AD 449094   Unclassified

Also published in Phys. Rev., v. 133: B831-B834, Feb. 10, 1964.

Using a particular parametrization of paths, the nonrelativistic propagator for a charged particle in a uniform magnetic field is derived by the Feynman method of summation over histories. It is shown that this sum is independent of the parameterization as long as the classical path is included. The result is used to obtain the density matrix for the systems. (Contractor's abstract)

72

Bege, J. R. M. Co., Arlington, Mass.

THE CATENARY IN SPACE: FREE MOTIONS OF FLEXIBLE LINES, by R. M. Langer. Final scientific rept. Dec. 1964, 90p. incl. illus. (Rept. no. 6454) (AFOSR-64-2517) (AF 49(638)1327) AD 611429
                    Unclassified

The nature and importance of the catenary in space (flexible systems in one dimension) are discussed. Equations of motion are developed in more complete and universal form than in the literature. The catenary is described by means of a system of four, first-order, quasi-linear, hyperbolic, partial differential equations. The special circumstances are treated where the first order system reduces to a standard second order wave equation familiar in the literature. The four characteristics of the hyperbolic system are found and also the vectors which help formulate combination variables suitable for the catenary problem. Some special solutions are presented for interesting catenary motions. A general treatment is formulated in terms of integral equations for the full catenary problem of planar motion with two independent variables and four dependent catenary parameters. Extensions to other novel problems are indicated. (Contractor's abstract)

73

Bell Aerosystems Co., Buffalo, N. Y.

ANALYSIS OF TRAINING ALGORITHMS FOR A CLASS OF SELF-ORGANIZING SYSTEMS, by J.

Goerner and L. Gerhardt. [1964] 6p. incl. diagrs. table. (AFOSR-64-2538) (AF 49(638)144) AD 453790   Unclassified

Presented at Third Symposium on Discrete Adaptive Processes, Nat'l. Electronics Conf., Chicago, Ill., Oct. 20-21, 1964.

In this paper, the n-dimensional vector approach is extended and used to analyze basic types of training algorithms. Certainly an n-dimensional space can not be directly visualized, but n-dimensional vectors and hyperplanes can at least be symbolized in a 3-dimensional space. It is shown how this geometric tool allows quasi visualization of the network training rules. At the same time, without the use of elaborate mathematics, this method of analysis can be used to determine the strength and weaknesses of the training algorithms and the effect of memory element saturation and imperfections.

74

Birmingham U. [Dept. of Chemistry] (Gt. Brit.).

STRUCTURAL STUDIES OF LINEAR MOLECULES BY MICROWAVE SPECTROSCOPY, by J. K. Tyler and J. Sheridan. Feb. 1963, 19p. (AFOSR-4822) (AF 61(052)241) AD 409439   Unclassified

Rotational constants were measured for several isotopic forms of fluorine cyanide and fluoroacetylene. Accurate bond-distances were computed for all the halogen cyanides and for fluoro- and chloracetylene, by the method of isotopic substitution at all atoms (except F and I). The CF bonds in these compounds are the shortest yet found. The CN distance is virtually constant at 1.159 A. The nuclear quadrupole coupling constant for N^{14} in fluorine cyanide, -2.67 mc/s, is the lowest yet measured for a cyanide grouping. The dipole moments of fluorine cyanide and fluoroacetylene, from Stark effects, are 2.17 D and 0.75 D respectively. Rotation spectra of molecules in excited bending vibrational states were analyzed for fluorine cyanide, fluoroacetylene and cyanoacetylene. (Contractor's abstract)

75

Birmingham U. [Dept. of Chemistry] (Gt. Brit.).

MICROWAVE SPECTROSCOPIC STUDIES OF MOLECULES, by J. Sheridan. July 18, 1963, 9p. (AFOSR-5270) (AF EOAR-62-1) AD 417348   Unclassified

A summary is given of the progress of microwave spectroscopic studies of the properties of several molecules in the period Jan. 1, 1962 to Dec. 31, 1962. Approximately 180 absorption lines were measured for acetyl acetylene, fifty of which were assigned to give accurate rotational constants. A preliminary analysis was made of the splittings due to internal rotation of the methyl group. Work was begun on deuterated species of this substance. Preliminary values of the a- and b-components of the dipole moment were obtained. About 100 lines were measured

for trifluoroethylene, and work on a tentative assignment was begun. Preliminary work on the linear molecules iodo-cyanoacetylene and bromo-cyanoacetylene was also initiated in the period covered. (Contractor's abstract)

76

Bolt, Beranek and Newman, Inc., Cambridge, Mass.

TRANSMISSION AND CODING OF INFORMATION IN AUDITORY NERVOUS SYSTEM. Final rept. Jan. 8, 1962 - Feb. 14, 1964. Feb. 14, 1964, 57p. incl. illus. diagrs. tables, refs. (AFOSR-64-0966) (AF 49(638)1142) AD 600222   Unclassified

Research conducted on the electrophysiological aspects of the auditory nervous system, the neural activity during learning, and the different stages of alertness during sleep is outlined. Summaries are presented for the following research studies: (1) Long Duration Auditory Evoked Potentials in Man During Sleep, (2) The Effects of Midbrain Lesions on Cortical Responses to Acoustic Stimuli, (3) Differences in the Functions of the Two Cerebral Hemispheres, (4) The Use of Anatomical and Physiological Evidence in Theory Construction, and (5) Temporal Pattern Discrimination in Lower Animals and Its Relation to Language Perception in Man.

77

Bolt, Beranek and Newman, Inc., Cambridge, Mass.

EXPERIMENTAL PROCEDURES AFFECTING EVOKED RESPONSES RECORDED FROM AUDITORY CORTEX, by G. M. Gerken and W. D. Neff. [1963] 11p. incl. diagrs. tables. (AFOSR-64-1161) (AF 49(638)1142) AD 442798   Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 15: 947-957, 1963.

Four pairs of surface to deep-cortex electrodes were implanted in auditory cortex in each of 6 cats. Electrocorticographic recordings were taken from the electrodes before, during, and after all presentations of 2 types of acoustic stimuli: a 4-sec train of clicks at 4000/sec used as the conditioned stimulus (CS) during conditioning, and a single click used as a test signal. The response evoked from auditory cortex of the unanesthetized preparation by an acoustic stimulus of abrupt onset is composed of a series of potential changes. The cortical responses evoked by the CS and by the single click were similar in form and magnitude. Systematic changes in the evoked response were observed during the preconditioning sessions. Increases in the evoked response occurred during the pseudo-conditioning sessions. During conditioning, changes in behavior preceded changes in the evoked response. (Contractor's abstract in part)

78

Boston U. [Dept. of Mathematics] Mass.

EFFICIENCY OF THE WILCOXON TWO-SAMPLE STATISTIC FOR RANDOMIZED BLOCKS, by G. E. Noether. [1963] 6p. incl. table. (AFOSR-4811) (AF AFOSR-61-78) AD 436485   Unclassified

Also published in Jour. Amer. Stat. Soc., v. 58: 894-898, Dec. 1963.

A measure is suggested of the efficiency of a randomized block design for the comparison of 2 treatments by means of a Wilcoxon-type analysis. It is shown how the efficiency can be estimated from data of a randomized block design. (Contractor's abstract)

79

Boston U. [Dept. of Mathematics] Mass.

NOTE ON THE KOLMOGOROV STATISTIC IN THE DISCRETE CASE, by G. E. Noether. [1963] 2p. (AFOSR-J1530) (AF AFOSR-62-369) AD 427513   Unclassified

Also published in Zeitschr. Theoretische und Angew. Stat., v. 7: 115-116, 1963.

A simple demonstration of the conservative character of the Kolmogorov test in the case of discrete distributions is given. (Contractor's abstract)

80

Boston U. [Dept. of Physics] Mass.

WIENER-HERMITE FUNCTIONAL EXPANSION IN TURBULENCE WITH THE BURGERS MODEL, by A. Siegel, T. Imamura, and W. C. Meecham. 1963, 8p. (AFOSR-4750) (AF AFOSR-62-177) AD 408480   Unclassified

A method is presented which exploits the nearness to Gaussianity of velocity probability distributions in turbulence, by expanding the velocity field function about the Gaussian approximation. Many of the mathematical manifestations of the method are such, that it is hard to obtain physical insight into them. Hence, a pilot project of a simplified nature is undertaken which uses instead of the Navier-Stokes or MHD equations the Burgers one-dimensional model equation. (Contractor's abstract)

81

Boston U. [Dept. of Physics] Mass.

WIENER-HERMITE EXPANSION IN MODEL TURBULENCE AT LARGE REYNOLDS NUMBERS, by W. C. Meecham and A. Siegel. [1964] 13p. (AFOSR-65-0093) (AF AFOSR-62-177) AD 455784   Unclassified

Also published in Phys. Fluids, v. 7: 1178-1190, Aug. 1964.

A Wiener-Hermite functional expansion is used to treat a random initial value process involving the Burgers model equation. The nonlinear model equation has many of the characteristics of the Navier-Stokes equation. It is found that the functional expansion converges better the larger the separation variable in the correlation function (the nearer to joint normal is the distribution). To the present order, the treatment is similar to a quasinormal assumption. The computations show that the correlation function quickly approaches an equilibrium form for quite different initial values. The power spectrum function approaches an equilibrium form also, where it falls off like the inverse second power of the wavenumber. (Contractor's abstract)

82

Boston U. [Dept. of Physics] Mass.

ANALYTICITY AND PHASE RETRIEVAL, by P. Roman and A. S. Marathay. [1963] 13p. (AFOSR-64-1013) (AF AFOSR-62-248) AD 441058
Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 1452-1464, Dec. 16, 1963.

The general problem of constructing a spectrum from the knowledge of the magnitude of its Fourier transform is considered. The question reduces to locating the zeros of the analytic continuation in the upper half-plane. It is shown that if the spectrum is real, the continuation of the complex zeroes in the u.h.p. either are on the imaginary axis or occur pairwise in a symmetrical position. If, in addition, the spectrum is equal to or less than zero, the zeros on the imaginary axis disappear. This condition also leads to the requirement that the continuation must be representable as a convolution of a function with itself. The analytic properties of this function and the equations to determine it are discussed. Possible ways to obtain the solution of the ensuing nonlinear eigenvalue problem are suggested. (Contractor's abstract)

83

Boston U. [Dept. of Physics] Mass.

A REMARKABLE CONNECTION BETWEEN KEMMER ALGEBRAS AND UNITARY GROUPS, by P. Roman. [1963] 7p. (AFOSR-64-1770) (AF AFOSR-63-385) AD 449266
Unclassified

Also published in Jour. Math. Phys., v. 5: 777-782, June 1964.

One example of a connection between a particle algebra and a semisimple Lie group is long known: the Dirac algebra generated by n elements furnishes the elementary spinor representation of the orthogonal group in n dimensions. This paper demonstrates a new kind of such a connection. It is shown that there exists a unique connection between the Kemmer algebra generated by n elements and the unitary group in a space of n + 1 dimensions. (Contractor's abstract)

84

Boston U. [Dept. of Physics] Mass.

A NEW PHENOMENOLOGICAL SUPERMULTIPLET STRUCTURE OF ELEMENTARY PARTICLES, by P. Roman. [1964] 10p. (AFOSR-64-2341) (AF AFOSR-63-385) AD 451927
Unclassified

Also published in Nuclear Phys., v. 57: 55-64, 1964.

Grouping together the known strongly interacting particles and resonances according to their spin value J and disregarding isospin, a simple two-parameter linear mass formula is found. One parameter characterizes each entire supermultiplet, the other varies from subset to subset. This second quantum number, together with isospin T, defines the hypercharge U and a new quantum number V, such that when taking also parity into account no degeneracy is left in the scheme. The mass formula is refined to incorporate isospin. A possible group theoretical background is suggested, which is based on the group U4. The symmetry breaking terms are discussed on general grounds. The possibility of incorporating electromagnetic and weak interactions is indicated. (Contractor's abstract)

85

Boston U. [Dept. of Physics] Mass.

THE ANGULAR DISTRIBUTION OF DELBRUCK SCATTERING, by J. C. Herrera and P. Roman. [1964] 10p. (AFOSR-65-0140) (AF AFOSR-63-385) AD 455634
Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1657-1666, Sept. 16, 1964.

The gauge-invariant effective Lagrangian is quantized and is used to form a transition matrix which then permits the application of standard covariant calculational tools of quantum electrodynamics for the low-energy range of vacuum polarization phenomena. The new technique is applied to the calculation of the differential cross-section, for arbitrary directions, of Delbruck scattering. The result is exact in the low-energy limit. (Contractor's abstract)

86

Boston U. Dept. of Physics, Mass.

SPECTRAL FUNCTIONS AND LAGRANGIAN THEORIES, by W. S. Hellman and P. Roman. [1964] [2]p. (AFOSR-65-0822) (AF AFOSR-63-385) AD 616205
Unclassified

Also published in Phys. Ltrs., v. 13: 336-337, Dec. 15, 1964.

In recent investigations concerning restrictions placed on Lagrangian field theories, the positive definiteness of the spectral weight function was found to be crucial for the results obtained. This note indicates that the requirement of positive definiteness might be too strong. A model is considered of nucleons and pions with pseudo-scalar coupling and with the bare pion mass (μ_0) set equal to 0. The ensuing discussion implies that the condition of non-negativeness on the spectral weight function is too strong for local Lagrangian theories.

87

Boston U. Dept. of Physics, Mass.

CONCERNING SPACE-TIME AND SYMMETRY GROUPS, by M. E. Mayer, M. Y. Han and others. [1964] [5]p. (AFOSR-65-0823) (AF AFOSR-63-385) AD 616206   Unclassified

Also published in Phys. Rev., v. 136: B668-B692, Nov. 9, 1964.

Several theorems are proved which exhibit the impossibility of constructing nontrivial products of the Lorentz group with internal symmetry groups for some physically interesting examples. It is also shown that if the Lorentz group is replaced by the Galilei group, qualitatively different results are obtained; a "linear" breakdown of internal symmetry is possible.

88

Boston U. Dept. of Physics, Mass.

A THEOREM ON THE ZEROS OF CAUSAL TRANSFORMS, by A. S. Marathay and P. Roman. [1964] [2]p. (AFOSR-65-1754) (AF AFOSR-63-385) AD 625557   Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1821-1822, Dec. 1, 1964.

A theorem is established which relates the zeros of causal transforms belonging to the folded spectra $g'(\mu) = g(2\nu_0 - \nu)$. For the case that the Fourier transform $\gamma(\tau)$ can be analytically continued into the complex τ-plane, the theorem states: If γ has a zero at $\tau = \tau_n$, then the Fourier transform of $g'(\nu)$, γ', will have a zero at the origo-reflected position $\tau' = \tau_n$.
A corollary follows: If $g(\nu)$ is a real, non-negative causal function with a cut-off, and if it has a symmetric shape about some frequency ν_0, then the zeros of $\gamma(\tau)$ are symmetric in the complete τ-plane with respect to both the imaginary and real axis.

89

Brandeis U. [Dept. of Biochemistry] Waltham, Mass.

EVOLUTION OF LACTIC DEHYDROGENASES, by A. C. Wilson, N. O. Kaplan and others. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-1512) (AF AFOSR-63-214) AD 623493   Unclassified

Also published in Fed. Proc., v. 23: 1256-1266, Nov.-Dec. 1964.

Twenty-five lactic dehydrogenases were purified and crystallized from various species. Several methods were used to compare the structures of these enzymes, including determinations of molecular wt, amino acid composition, and fingerprint pattern. Lactic dehydrogenases in crude extracts of many other species were investigated by measurements of temperature stability, electrophoretic mobility, and catalytic activity with coenzyme analogs. The quantitative microcomplement fixation method was used to compare the structures of hemoglobins and of several other proteins. The method is more sensitive to differences in protein structure than are conventional, quantitative immunological methods. Single amino acid differences among hemoglobins are easily detected by this method. The method also provides an approximate measure of the degree of structural resemblance between various hemoglobins of known sequence. Microcomplement fixation was used to examine the rates of protein evolution. The proteins studied were H_4 and M_4 lactic dehydrogenases, triose phosphate dehydrogenase, glutamic dehydrogenase, aldolase, and hemoglobin. The results suggest that, in a given species, all these proteins tend to change in immunological structure at similar rates.

90

Brandeis U. [Dept of Physics] Waltham, Mass.

[TOPICS IN CLASSICAL AND QUANTUM AND MANY-BODY THEORY], by E. P. Gross. Final interim rept. Jan. 1963, 4p. (AFOSR-4456) (AF 49(636)27) AD 295833   Unclassified

Research concerns quantum theory of the many body problem with particular application to liquid helium, the interaction of nonrelativistic particles and quantum fields, and classical kinetic theory of gases. Of particular concern is liquid helium because it is one of the simplest many body systems and yet has an incredible richness of behavior. It may in time become the best understood many body system and serve as a prototype for other studies. The pattern of investigation is (1) an understanding of the qualitatively distinct possible ground states for a system of interacting bosons (gas, liquid, solid, etc.); (2) characterization of the possible excitations, i. e., phonon-roton spectrum, shear waves, vortices; (3) analysis of the effects of probes, i. e., x-rays, inelastic scattering of neutrons, foreign atom and ion behavior, etc.; (4) statistical thermodynamics; and (5) kinetics of interactions of excitations and the microscopic derivation of two fluid hydrodynamics.

91

Brandeis U. [Dept. of Physics] Waltham, Mass.

INTERACTION BETWEEN GAUGE VECTOR FIELDS, by R. Arnowitt and S. Deser. [1963] 11p. (AFOSR-64-0557) (AF AFOSR-63-366) AD 434311
Unclassified

Also published in Nuclear Phys., v. 49: 133-143, 1963.

The interaction between massless vector fields possesses gauge invariance of the second kind and the Maxwell field is considered. A discussion is given of the special properties of gauge fields and of the definition of minimal electromagnetic coupling. The inconsistency of minimal coupling for the systems in question is reviewed. It is shown that while a particular non-minimal coupling is consistent for the fields in question, even the latter becomes inconsistent in the presence of other known charged fields. Thus such fields as that of Yang-Mills or the baryon gauge field cannot charge unless all other charged fields in nature also form appropriate multiplets. (Contractor's abstract)

92

Brandeis U. [Dept. of Physics] Waltham, Mass.

EXTERNAL SOURCES IN GAUGE THEORIES, by D. G. Boulware and S. Deser. [1963] 11p. (AFOSR-64-0794) (AF AFOSR-63-366) AD 436370
Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 1009-1019, Nov. 16, 1963.

The notion of prescribed external sources is discussed for gauge fields. Such sources necessarily obey conservation laws which generally involve the fields themselves. The implications of these conservation requirements are analyzed for classical and quantized vector multiplets and for general relativity. A number of the vector source components may be prescribed independent of the field. The nonlocal components cannot be eliminated from the theory by a choice of coordinate frame and it is concluded that external gravitational sources are not useful in analyzing the fields properties. (Contractor's abstract)

93

Brandeis U. [Dept. of Physics] Waltham, Mass.

AMBIGUITY OF HARMONIC-OSCILLATOR COMMUTATION RELATIONS, by D. G. Boulware and S. Deser. [1963] 5p. (AFOSR-64-0795) (AF AFOSR-63-368) AD 438371
Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 230-234, Oct. 10, 1963.

The possibility, first noticed by Wigner, that the form of the Hamiltonian together with the Heisenberg equations do not imply canonical commutation relations for the harmonic oscillator variables, is re-examined here. It is shown that this freedom of commutation relations just expresses the known possibility of quantizing the system by Bose or Fermi (and para-Fermi) statistics, and altering the zero-point energy. (Contractor's abstract)

94

Brandeis U. [Dept. of Physics] Waltham, Mass.

SPONTANEOUS SYMMETRY BREAKDOWN IN μ e ELECTRODYNAMICS, by R. Arnowitt and S. Deser. [1964] [3]p. (AFOSR-65-0818) (AF AFOSR-63-368) AD 617239
Unclassified

Also published in Phys. Ltrs., v. 13: 256-258, Dec. 1, 1964.

This note examines the possibility of spontaneous symmetry breakdowns in the electrodynamics of 2 originally identical charged fields with minimal coupling. The analysis provides a simple example of an internal symmetry, SU(2), for which 3 possibilities arise: (1) no spontaneous breakdowns occur and the vacuum state possesses full SU(2) invariance; (2) a partial breakdown occurs which will be seen to produce a mass splitting out of $\mu \to e + \gamma$ decay; and (3) full SU(2) breakdown occurs which will result, in general, in allowed $\mu \to e + \gamma$ decay as well as a mass splitting. Only minimal gauge invariant interactions are involved, and hence divergencies and cut off problems are avoided.

95

British Columbia U. Dept. of Chemistry, Vancouver (Canada).

REACTIONS OF $O_2(^1\Delta_g)$ AND $O_2(^1\Sigma_g^+)$, by L. W. Bader and E. A. Ogryzlo. Jan. 14, 1964, 11p. incl. diagrs. refs. (AFOSR-64-2431) (AF AFOSR-63-158) AD 453781
Unclassified

Also published in Discussions Faraday Soc., No. 37: 46-56, Jan. 1964.

A method of obtaining measurable concentrations of excited oxygen for kinetic studies has been developed, and a number of reactions of these excited molecules are described. Evidence is presented for simultaneous electronic transitions in a weakly bound complex between two $O_2(^1\Delta_g)$ molecules resulting in emission bands at 6340 and 7030A. The phenomenon is discussed in terms of the association theory of gases.

96

British Columbia U. Dept. of Chemistry, Vancouver (Canada).

HALOGEN-ATOM REACTIONS. II. LUMINESCENCE

FROM THE RECOMBINATION OF CHLORINE ATOMS, by L. W. Bader and E. A. Ogryzlo. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-0380) (AF AFOSR-63-158) AD 611900   Unclassified

Also published in Jour. Chem. Phys., v. 41: 2926-2930, Nov. 1, 1964.

A spectroscopic study of an orange-red glow from the products of electrical discharge in chlorine has resulted in an identification of the emitter as $Cl_2(A^3\Pi_{0u}{}^+)$. A kinetic study has provided evidence for the formation of excited molecules in this state by the preassociation of $^2P_{3/2}$ chlorine atoms. Several detailed mechanisms for the reaction are discussed.

97

British Columbia U. [Dept. of Mathematics] Vancouver (Canda).

THE CURRENT THEORY OF ANALYTIC SETS, by D. W. Bressler and M. Sion. [1964] [24]p. incl. refs. (AFOSR-4810) (AF AFOSR-62-261) AD 441468   Unclassified

Also published in Canad. Jour. Math., v. 16: 207-230, 1964.

In th's paper the outlines of the theory of analytic s.'s are described from the point of view of recent work on the subject. The emphasis is on a general topological setting. Three Borel families, the family of Sousl' sets, and the family of analytic sets are introduced and relations between these families are discussed. A proximation theorems and miscellaneous results are given. Perhaps the best known of recent results is Choquet's theorem in potential theory about the capacitability of analytic sets. Choquet's theorem is concerned with approximation from below. In many problems involving approximation from below the natural family to consider is that of analytic sets, not some Borel family.

98

British Columbia U. [Dept. of Mathematics] Vancouver (Canada).

A CHARACTERIZATION OF WEAK CONVERGENCE, by M. Sion. [1964] 15p. (AFOSR-65-0355) (/.F AFOSR-62-261) AD 632590   Unclassified

Also published in Pacific Jour. Math., v. 14: 1059-1067, 1964.

For X a locally compact, Hausdorff space and $\{\mu_i; i \in D\}$ a net of Radon measures on X, the weak* limit of this net is the Radon measure ν such that $\lim_i \int f d\mu_i = \int f d\nu$ for every continuous function f vanishing outside some compact set. A Radon measure φ^* is constructed from a given base B for the topology of X and $\lim \inf_i \mu_i$. φ^* is obtained from another measure φ by a standard regularizing process. A condition is given for $\varphi = \varphi^*$, that is, for a measure constructed through an abstract process from the μ_i to be, in the topological situation, the weak* limit of the μ_i. An example is given to show this condition cannot be eliminated.

99

British Columbia U. Dept. of Physics, Vancouver (Canada).

BIPOLAR THEORY OF METAL-SEMICONDUCTOR CONTACTS UNDER ARBITRARY INJECTION LEVELS, by R. E. Horita and R. E. Burgess. Mar. 27, 1963, 12p. (AFOSR-64-0259) (AF AFOSR-61-91) AD 432526   Unclassified

Also published in Canad Jour. Phys., v. 41: 1010-1021, July 1963.

Metal-semiconductor contacts have been known empirically to obey a modified diode equation $I = I_s (\exp qV/akT -1)$, where the parameter a often took values greater than theoretical limit of two. Previous theories could not simply account for this anomaly. The model presented in this paper considers one-dimensional bipolar flow of carriers with zero recombination in a homogeneous semiconductor filament with a rectifying and an ohmic contact at opposite ends. The zero-electron-current theory by Borneman et al valid for low injection levels, is extended to arbitrary injection levels by the use of the Misawa junction relations. Then the nonzero-electron-current theory is developed. This theory shows that a is unity for low injection into extrinsic semiconductors and that $a = (3 \cdot M-/(b-M)$ for arbitrary injection into intrinsic semiconductors and for high extrinsic semiconductors; M is the electron-to-hole current ratio and b is the electron-to-hole mobility ratio. Thus a can take any value depending on the magnitude of M/b.

100

British Columbia U. Dept. of Physics, Vancouver (Canada).

DIRECT TUNNEL-CURRENT NOISE IN TUNNEL DIODES FOR SMALL BIASES, by B. E. Turner and R. E. Burgess. [1964] [12]p. incl. diagrs. (AFOSR-66-1595) (AF AFOSR-61-91) AD 640281   Unclassified

Also published in Canad. Jour. Phys., v. 42: 1046-1057, June 1964.

The Esaki theory describing the current components arising from direct interband tunneling in tunnel diodes has previously been used to predict a relation between the noise spectrum of direct-tunneling currents and the p-n junction voltage (Pucel 1961). In this paper is presented experimental confirmation of this relation which provides a sensitive test of the Esaki formulation for tunneling currents and indicates as well, that the noise spectrum is independent of the

band structure of the semiconductor and that the two oppositely flowing tunnel currents are uncorrelated. These facts form a basis for examining the extent to which the Esaki formulation can be generalized and the relation independent of band structure, between the direct tunnel-current noise spectrum and the applied junction voltage.

101

British Columbia U. [Dept. of Physics] Vancouver (Canada).

PHYSICAL PROCESSES AND FLUCTUATIONS IN SEMICONDUCTOR SYSTEMS DISPLAYING NEGATIVE RESISTANCE, by R. E. Burgess. Annual rept. Jan. 1, 1962 - Mar. 31, 1963. 5p. (AF AFOSR-63-91) AD 402271   Unclassified

The research was devoted to the following topics which are discussed in detail: (1) the negative resistance in semiconductors arising from thermal mechanisms and the associated electrical fluctuations, and (2) fluctuations of temperature and heat flow in conductors in macroscopic equilibrium and their relation to the thermal fluctuations of electromagnetic field in a solid plasma. These items were the subjects of theoretical investigations while the experimental studies so far were used to determine the validity of the linear models used in the analytical work.

102

Brown U. [Dept of Physics] Providence, R. I.

[RESEARCH ON ELECTRONIC PROPERTIES OF METALS], by R. W. Morse. Final rept. 1963, 1v. incl. refs. (AFOSR-J1620) (AF 49(638)6) AD 429766   Unclassified

This document contains reprints on the following subjects: Ultrasonics in metals at very low temperatures, Interaction of acoustical waves and electrons, Magnetoacoustic effect, Fermi surfaces of gold and silver from ultrasonic attenuation, and Some ultrasonic measurements in normal and superconducting aluminum.

103

Brown U. [Dept. of Physics] Providence, R. I.

STUDY OF THE ATTENUATION OF ULTRASONIC SHEAR WAVES IN SUPERCONDUCTING ALUMINUM, by L. T. Claiborne, Jr. and R. W. Morse. [1964] [13]p. incl. diagrs. table, refs. (AFOSR-65-0784) (AF AFOSR-63-267) AD 616203   Unclassified

Also published in Phys. Rev., v. 136: A893-A905, Nov. 16, 1964.

This article reports and interprets experiments which were conducted to determine the temperature dependence of shear-wave attenuation in superconducting aluminum. Some of the main results are: (1) In

contrast to the longitudinal-wave attenuation, the experiments showed a strong frequency dependence of the reduced attenuation (α_s/α_n) as a function of temperature; (2) The temperature variation of (α_s/α_n) could be separated into two parts: (a) a very sharp decrease with temperature very close to the transition temperature and (b) a residual attenuation having a temperature dependence similar to that for longitudinal waves: (3) A theoretical formulation was made which used approximations expected to be valid near the transition temperature. This theory employed a self-consistent treatment of the electron-impurity collisions and qualitatively reproduced the features of the experimental data; (4) It was found that the specific details of the data could be predicted by this theory when the function $2f(\epsilon)$ was used for the normal electron density; and (5) In particular the residual attenuation was shown to be $g[2f(\epsilon)]$, and the width of the region of rapid-falling attenuation was shown to be determined by $\omega\tau$.

104

Brown U. Div. of Applied Mathematics, Providence, R. I.

APPLICATIONS OF LIAPUNOV STABILITY THEORY TO CONTROL SYSTEMS, by J. P. LaSalle. [1964] [15]p. incl. refs. (AFOSR-66-2609) (AF AFOSR-64-693) AD 64342P   Unclassified

Also published in Proc. IBM Scientific Computing Symposium, Control Theory Applications, Thomas J. Watson Research Center, Yorktown Heights, N. Y., Oct. 19-21, 1964, p. 61-75.

The application of Liapunov theorems to autonomous (stationary) systems along with a few simple examples is discussed. The Liapunov theory for autonomous systems is today quite complete and all major theorems on stability and instability of Liapunov type can be obtained from two basic theorems presented. It is pointed out why the study of stability of nonautonomous (time-varying) systems is difficult. Indications are given that improved methods can be devised for analyzing the stability of non-autonomous systems. Recent results on the stability of functional differential equations and stochastic differential equations are also described.

105

Brown U. Div. of Engineering, Providence, R. I.

A GENERAL SOLUTION OF THE HOPF CHARACTERISTIC FUNCTIONAL EQUATION FOR TURBULENCE, by I. Hosokawa. May 1964 [17]p. (Technical rept. no. WT-39) (AFOSR-64-1113) (AF 49(638)1295) AD 447664   Unclassified

The aim of this paper is to point out that a general solution of the Hopf Φ equation in turbulence theory consists already in his definition of the characteristic functional, and it is equivalent to Rosen's solution. In addition the decay of isotropic turbulence is considered based upon the present integral representation.

106

Brown U. Div. of Engineering, Providence, R. I.

THE METHOD OF FUNCTIONALS IN TURBULENCE
THEORY, by I. Hosokawa. May 1964 [38]p. incl.
refs. (Technical rept. WT-41) (AFOSR-64-1396)
(AF 49(638)1295) AD 607643   Unclassified

The paper consists of two parts. Part I deals with a
formulation of the generalized characteristic functional
for random fields. This formulation is a generaliza-
tion of the theory of Hopf so as to include space- as
well as time-correlations of the fields. At the same
time, it is shown that the Gaussian functional solution
can exist also for our generalized characteristic func-
tional as a counterpart of Hopf's solution for incom-
pressible, inviscid Navier-Stokes turbulence. In
Part II a general solution is constructed by superposi-
tion of the particular solution, slightly modified from
what has been found in Part I. Accordingly, the ex-
pression for the solution is in terms of a functional
integration.

107

Brown U. Div. of Engineering, Providence, R. I.

A.C. SOLENOID OF FINITE LENGTH IN A CON-
DUCTING MEDIUM WITH HALL CONDUCTIVITY, by
S. Selamoglu and P. F. Maeder. June 1964, 85p.
incl. diagrs. (Technical rept. WT-40) (AFOSR-64-
2028) (AF 49(638)1295) AD 609462   Unclassified

The electric field due to an alternating current carry-
ing solenoid was investigated by the field approach.
The solenoid was assumed to be in an infinite, uni-
form, conducting medium, which may exhibit the Hall
effect caused by a constant, axial, external magnetic
field. Both the infinite and finite coil problems were
studied. Explicit solutions to the infinite coil were
found while the finite coil solutions were obtained in
integral form. From the latter, the coil impedance
and the voltage induced in a particular wire loop were
calculated numerically for different scalar and Hall
conductivities at different length-to-diameter ratios.
Some experimental evidence for the calculated values
of the impedance without the Hall effect also was
found. (Contractor's abstract)

108

Brown U. [Div. of Engineering] Providence, R. I.

SECULAR BEHAVIOR IN AN ANALYSIS OF DAMPED
STANDING WAVES IN A GAS, by T. F. Morse. [1964]
[5]p. (AFOSR-65-0278) (AF 49(638)1326) AD 611456
                                        Unclassified

Also published in Phys. Fluids, v. 7: 1691-1695,
Oct. 1964.

By considering multiple time scale behavior in the
viscous damping of a one-dimensional wave, it has
been shown how secularities (terms growing un-
bounded in time) present in the Hilbert solution of

this problem may be eliminated. The method of time
scales and the accompanying freedom to remove secu-
lar terms overcomes in part the major disadvantage
of the Hilbert procedure which requires a periodic
renormalization of the lowest order initial conditions.
This method, which has proved most useful in non-
equilibrium statistical mechanics, provides a link be-
tween the Hilbert and Chapman-Enskog treatment of a
simple hydrodynamic problem.

109

Bryn Mawr Coll. [Dept. of Psychology] Pa.

APPARENT DISTANCE IN A HORIZONTAL PLANE
WITH TACTILE-KINESTHETIC STIMULI, by R. S.
Davidon and M.-F. H. Cheng. Apr. 16, 1963, 5p.
(AFOSR-64-2541) (AF AFOSR-62-1) AD 453806
                                        Unclassified

Also published in Quart. Jour. Exper. Psychol., v.
16: 277-281, 1964.

In the study of active tactile-kinesthetic space percep-
tion apparent distance has been found to vary as a
function of the direction of the line segment in a hori-
zontal plane. The present data indicate that the er-
ror is not consistently related to the same frame
or reference as the visual illusion. Rather, with
movement of the extended arm to determine the rela-
tive distances between pairs of points, radial dis-
tances are overestimated in relation to tangential ones,
whether parallel or perpendicular to the medial plane.
Interpretations are in terms of kinesthetic stimulus
patterns and the structure of perceptual representa-
tion.

110

Budd Co. [Inc.] Information Sciences Center,
    McLean, Va.

STUDY OF PICTORIAL DATA ANALYSIS CONCEPTS
AND TECHNIQUES. Final rept. Apr. 1, 1963 - Apr.
30, 1964. May 31, 1964, 127p. (AFOSR-64-2529)
(AF 49(638)1231) AD 609711   Unclassified

The problem of developing rules for subdividing com-
plex pictures into 'uniform' regions is discussed.
Experiments are described in which rules of this type
applicable to 'one-dimensional' pictures are derived
from an analysis of observers' subdivision prefer-
ences. This report also includes: Systems for Gen-
erating One-Dimensional Patterns, by A. Rosenfeld
and A. Goldstein, Applied Optics, v. 3: Apr. 1964.
(Contractor's abstract)

111

nos Aires U. Inst. de Anatomía General y
    Embriología (Argentina).

THE 5-HYDROXYTRYPTAMINE CONTENT AND
SYNTHESIS OF NORMAL AND DENERVATED

PINEAL GLAND, by A. Pellegrino de Iraldi, L. M.
Zieher, and E. De Robertis. [1963] [6]p. incl. tables,
refs. (AFOSR-65-2745) (AF AFOSR-62-333)
AD 629053   Unclassified

Also published in Life Sci., No. 9: 691-696, 1963.

By bioassay the 5-hydroxytryptamine (5-HT) content of
the pineal gland was determined in normal rats and
after 5 to 30 days of bilateral extirpation of the superior
sympathetic ganglia. The normal 5-HT content varied
between 10 and 20 NG of 5-HT base per pineal with a
mean of 14.5 ± 1.3 which corresponds to 11.1 μg/g.
In brain the normal content was approximately 0.28
μg/g. Denervation produces a decrease in 5-HT of
73% after 5 days, which stabilizes at about +50%, be-
tween 10 to 30 days. The injection of 25 mg/kg 5-
hydroxytryptophan increased the 5-HT content of the
normal gland by 400% in 30 min. In brain the increase
was 200%. In the denervated gland the synthetic capacity
for 5-HT is reduced to about 1/5 of the normal. The
injection of 25 mg/kg of 5-HT showed no uptake by the
normal pineal glands and by brain after 10 min. How-
ever the denervated gland increased the 5-HT content
above the control level. The existence of two pools of
5-HT in the pineal gland, one in nerves and the other
in the pinealocytes is demonstrated and some of their
properties are discussed.

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Buenos Aires U. Inst. de Anatomía General y
Embriología (Argentina).

ACTION OF RESERPINE, IPRONIAZID AND
PYROGALLOL ON NERVE ENDINGS OF THE PINEAL
GLAND, by A. Pellegrino de Iraldi and E. De Robertis.
[1963] [11]p. incl. illus. diagr. refs. (AFOSR-65-
2746) (AF AFOSR-62-333) AD 629054 Unclassified

Also published in Internat'l. Jour. Neuropharmacol.,
v. 2: 231-239, 1963.

Drugs that may change the metabolism of catechola-
mines and indolamines have been used in order to in-
vestigate the nature of the granulated vesicles found in
adrenergic nerve endings in the pineal gland of the rat.
In normal endings, 30-40% of the vesicles are granu-
lated and the rest are homogeneous. The proportion of
granulated vesicles diminish considerably between 2-
48 hr after a single injection of reserpine and this is
slowly restored to normal levels in a period of 8 days.
A single injection or chronic treatment with iproniazid
(a MAO inhibitor) increases the proportion of granulated
vesicles, and also the size of the vesicles and granules.
Iproniazid prior to reserpine protects the nerve endings
from the depletion of granulated vesicles. Pyrogallol
(a COMT inhibitor) does not change the concentration of
granulated vesicles and does not protect the nerve
ending from the action of reserpine. These results are
interpreted as supporting the concept that the granulated
vesicles contain the adrenergic transmitter. The possi-
ble mechanism of action of these drugs on the submicro-
scopic structure of adrenergic nerve endings is dis-
cussed. (Contractor's abstract)

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Buenos Aires U. Inst. de Anatomía General y
Embriología (Argentina).

5-HYDROXYTRYPTOPHAN-DECARBOXYLASE
ACTIVITY IN NORMAL AND DENERVATED PINEAL
GLAND OF RATS, by A. Pellegrino de Iraldi and G.
Rodriquez de Lores Arnaiz. [1964] [5]p. incl. table,
refs. (AFOSR-65-2835) (AF AFOSR-63-314)
AD 628433   Unclassified

Also published in Life Sci., v. 3: 589-593, 1964.

The 5-hydroxytryptophan decarboxylase was deter-
mined in normal and denervated pineal glands. In the
experimental glands the determination was made at
2.5, 5, 10, 12 and 30 days after bilateral gangliectomy
of the superior sympathetic ganglia. The results show
an increase in enzyme activity in the denervated gland
which may be as large as 150% after 2.5 days and
persists until 30 days. The tentative hypothesis is
postulated that the pineal nerves contain an inhibitory
substance of the enzyme which disappears after denerva-
tion.

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Buenos Aires U. Inst. de Anatomía General y
Embriología (Argentina).

A NON-CHOLINERGIC SYNAPTIC INHIBITION IN THE
CENTRAL NERVOUS SYSTEM OF A MOLLUSC, by H.
M. Gerschenfeld. [1964] [4]p. incl. illus. (AFOSR-
65-1942) (AF AFOSR-64-656) AD 623368
                                   Unclassified

Also published in Nature, v. 203: 415-416, July 1964.

In Cryptomphallus aspersa it has been found a type of
neurons that in addition to a cholinergic excitatory input
show a direct inhibitory synaptic input and present a
typical pattern of synaptic activity. Usually a single
block shock provokes a direct inhibitory post-synaptic
potential (IPSP) followed by a depolarization and an ex-
citatory burst. A short repetitive stimulation provokes
the firing of an inhibitory interneuron originating a repe-
titive response of elementary IPSP (generally 20-30),
lasting 30-60 sec. The equilibrium potential of the IPSP
is about -60 mV. Acetylcholine (ACh) depolarizes these
cells even when the inhibitory interneuron is firing, be-
ing clear that ACh cannot be the inhibitory synaptic
transmitter in these neurons. dTC and atropine block
the excitatory input. o-adrenergic blocking agents have
not effected the IPSPs; it was not possible to investigate
the effect of ß-adrenergic blocking agents since these
drugs impair nerve conduction or interneuron firing.
Picrotoxin, tetanus toxin, metrazol, strychnine were
ineffective in modifying the inhibitory input.

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Buenos Aires U. Inst. de Anatomía General y
Embriologia (Argentina).

ACTION OF GLUTAMIC ACID AND OTHER

NATURALLY OCCURRING AMINO-ACIDS ON SMALL
SNAIL CENTRAL NEURONS, by H. M. Gerschenfeld and
A. Lasansky. [1964] [14]p. incl. illus. diagrs. refs.
(AFOSR-65-1944) (AF AFOSR-64-656) AD 623369
Unclassified

Also published in Internat'l. Jour. Neuropharmacol.,
v. 3: 301-314, 1964.

The action of glutamic acid (Glut. Ac.) and some other
naturally occurring aminoacids in molluscan nervous
system was studied in the neurons of the snail Cryptom-
phallus aspersa and Helix pomatia with intracellular re-
cording and perfusion and/or microinjection of drugs.
Neurons are sensitive to Glut. Ac. in concentrations as
low as 5×10^{-7}M. Glut. Ac. depolarizes some cells
while others are hyperpolarized and inhibited. The
equilibrium potential of this last effect is about -60 mV.
Glut. Ac. receptors show desensitization only when Glut.
Ac. is depolarizing. A reduction of the membrane re-
sistance is observed when Glut. Ac. is added in a con-
centration of 10^{-3}M. Mono and dicarboxilic aminoacids
may or may not have the same effect on different
neurons. In a great number of cells GABA has a de-
polarizing effect.

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Buenos Aires U. Inst. de Anatomía General y
Embriología (Argentina).

IONIC MECHANISM ASSOCIATED WITH NON-
CHOLINERGIC SYNAPTIC INHIBITION IN MOLLUSCAN
CENTRAL NEURONS (Abstract), by H. M. Gerschenfeld
and D. J. Chiarandini. [1964] [1]p. (AFOSR-65-1945)
(AF AFOSR-64-656) Unclassified

Presented at Nineteenth annual meeting of the Society
of General Physiologists, Woods Hole, Mass., 1964.

Two types of IPSP have been described in gasteropod
neurons: one probably cholinergic and another non-
cholinergic. Cholinergic IPSP appear to be produced
by changes in membrane permeability to both Cl^- and K^+.
The ionic basis of non-cholinergic IPSP was studied
in neurons of Cryptomphallus aspersa using double-
barraled microelectrodes. The intracellular injection
of Cl^- or the replacement of extracellular Cl^- by SO_4
did not alter the amplitude and reversal potential
(E_{ipsp}) of IPSP. On the contrary, varying the extra-
cellular concentration of K $[K]_0$ from 1 to 45 mM, the
amplitude of IPSP and E_{ipsp} changed markedly. In-
crease in $[K]_0$ provoked progressive diminution in the
amplitude of IPSP in spite of increasing depolarization.
Plotting log $[K]_0$ against E_{ipsp} results in a straight line
whose slope is near to the theoretical one predicted by
the Nernst equation.

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Buenos Aires U. Inst. de Anatomía General y
Embriología (Argentina).

[IONIC BASIS OF SYNAPTIC INHIBITION IN

MOLLUSCAN CENTRAL NEURONS] Bases ionicas de
la inhibicion sinaptica en neuronas centrales de
moluscos (Abstract), by D. J. Chiarandini and H. M.
Gerschenfeld. [1964] [1]p. (AFOSR-65-1946)
(AF AFOSR-64-656) Unclassified

Also published in Proc. Latinoamer. Congr.
Physiological Sci., Viña del Mar (Chile) (Nov. 23-28,
1964).

The ionic mechanisms associated with the origin of the
cholinergic and non-cholinergic inhibitory postsynaptic
potential have been studied in the central neurons of
Cryptomphallus aspersa, with intracellular recordings.
The intracellular injection of Cl or the gradual replace-
ment of the Cl^- existing in the external solution by SO_4
provoke progressive reduction of the cholinergic IPSP's
amplitude and of its equilibrium potential. If the ex-
ternal concentration of K ($[K]_0$) is increased it is ob-
served a less marked diminution in the size of the
cholinergic IPSP. The intracellular injection of Cl^- or
the replacement of this anion in the external environ-
ment by SO_4 have no effect on the size of the IPSP and
on the EIPSP. On the contrary, when $[K]_0$ is increased
from 1 to 45 mM the IPSP diminishes and the value of
the EIPSP decreases. From the present results it may
be concluded that cholinergic IPSP are due to simultane-
ous fluxes of Cl^- and K^+ while noncholinergic IPSP are
due only to an efflux of K^+.

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Buenos Aires U. Inst. de Anatomía General y
Embriología (Argentina).

[ELECTROPHYSIOLOGICAL STUDY OF 5-HYDROXY-
TRYPTAMINE RECEPTORS IN MOLLUSCAN NEURONS]
Receptores triptaminergicos en neuronas centrales de
moluscos (Abstract), by H. M. Gerschenfeld and E.
Stefani. [1964] [1]p. (AFOSR-65-1948) (AF AFOSR-
64-656) Unclassified

Also published in Proc. Latinoamer. Congr.
Physiological Sci., Viña del Mar (Chile) (Nov. 23-28,
1964).

Iontophoretic injections of 5-HT, on molluscan neurons
always have a depolarizing effect. It has been calculated
from the corresponding diffusion equation that a con-
centration of 5-HT of 5×10^{-10}M produces a depolariza-
tion of 7 mV. 5-HT increases twice the membrane con-
ductance and this change only lasts one third of the
potential change. Analyzing dose-response curves it
was found that lysergic acid and its derivatives block
competitively 5-HT receptor, while atropine and
morphine block non-competitively 5-HT receptor.
Monoamineoxidase inhibitors such as SKF 385 and iso-
carboxaside block competitively 5-HT receptor. Trypta-
mine, cyproheptadine and dibenamine block irreversibly
5-HT receptor. In the same patch of membrane, CILDA
neurons have 5-HT and Acetylcholine (ACh) receptors;
there is no crossed desensitization between 5-HT and
ACh receptors. Atropine blocks competitively ACh re-
ceptors and non-competitively ACh receptors, this

indicates that the two-receptors are different, but further work is needed. All these results make 5-HT a suitable candidate as a synaptic transmitter to CILDA neurons.

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Bureau of Mines, Bartlesville, Okla.

THERMOCHEMISTRY OF BORON AND SOME OF ITS COMPOUNDS. THE HEATS OF FORMATION OF TRIMETHYLAMINEBORANE AND ORTHOBORIC ACID, by W. D. Good, M. Mansson, and J. P. McCullough. July 1963, 15p. incl. table, refs. (CSO-680-59-9) AD 402335   Unclassified

A rotating-bomb calorimetric technique was developed to solve the problem of determining the heats of combustion of organic boron compounds. The heats of combustion of crystalline boron and trimethylamineborane, $(CH_3)_3NBH_3$, were determined. The combustion product was a solution of fluoboric acid in excess aqueous HF. The standard of formation of trimethylamineborane is -34.04 ± 0.55 kcal/mol. The heat of solution of orthoboric acid in an HF solution chosen to yield the same fluoboric acid solution was determined. The heat of formation of orthoboric acid was calculated to be -261.47 ± 0.20 kcal/mol. Combination of these results with data from the literature permitted calculation of the heats of formation of B_2O_3 and B_2H_6 referred directly to crystalline boron.

120

Bureau of Social Science Research, Inc., Washington, D. C.

CAPTIVITY LORE AND BEHAVIOR IN CAPTIVITY, by A. D. Biderman. [1964] [28]p. incl. refs. (AFOSR-65-0577) (AF 49(638)727) AD 615363   Unclassified

Also published in The Threat of Impending Disaster, Cambridge, M.I.T. Press, 1964, p. 223-250.

The relationship between the behavior of a prisoner of war and his precapture exposure to cultural lore about captivity are discussed. Special consideration is given to modern cultural concepts of the captive situation and prisoner conduct as compared to actual experience. The discussion focuses on studies of survivors of captivity in Korea and China.

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Bureau of Social Science Research, Inc., Washington, D. C.

RATIONALISM AND EMPIRICISM IN STUDIES OF BEHAVIOR IN STRESSFUL SITUATIONS, by S. Z. Klausner. Oct. 1964, 32p. incl. tables, refs. (AFOSR-64-2256) (AF 49(638)992) AD 608633   Unclassified

Every scientific researcher proceeds rationalistically as well as empiristically. Each may be classified in terms of a tendency to one or the other pole but not in terms of 'either-or'. The literature of the philosophy of science discusses the wisdom of empiricistic or rationalistic approaches. This paper, however, is empirical rather than philosophical. Consequently, it does not discuss the problem of 'wisdom', but rather examines (1) the extent to which empiricistic and rationalistic orientations are found in research reports of a single field, that of human behavior in stressful situations, and (2) the personal and social conditions which are associated with each of these orientations. It is concluded that the tendency to increase the proportion of observation terms among researchers in this group to be empiricistic increases when a researcher is working in a field not his own, when he is a younger professional, when his personality tends to be introverted, when he is a non-Catholic and when he is politically conservative.

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Bureau of Social Science Research, Inc., Washington, D. C.

CONCEPTS AND INDICATORS IN STUDIES OF BEHAVIOR UNDER STRESS, by S. Z. Klausner. Oct. 1964, 54p. (AFOSR-65-0137) (AF 49(638)992) AD 610808   Unclassified

An indicator is defined as a term which gives instruction about where to look for observable evidence about the concept referent. Scientific effort has concentrated mainly upon establishing general propositions stating a relation among concept referents and weaving these propositions into a theoretical network. Little consideration has been given to the link between the concept referents and the observables suggested by their indicators. This paper discusses and gives examples of various types of concept-indicator relationships, and presents one way of classifying the inferences made by researchers in linking concepts and their indicators. A special study of the distribution of these inferences among students of one field, the study of human behavior under stressful conditions, is included.

123

California Inst. of Tech., Pasadena.

STRUCTURE OF LIQUIDS, by C. J. Pings. Final
technical rept. Feb. 28, 1964, 14p. incl. refs.
(AFOSR-64-0581) (AF AFOSR-62-141) AD 434304
Unclassified

Experimental studies have continued on the forces
and configurations at the molecular level in simple
liquids. Two different x-ray diffraction set-ups for the
study of the diffraction pattern from liquid samples
have been put into operation and have been used for ex-
tensive measurements on liquid gallium in the super-
cooled region and on liquid argon at pressures up to
80 atm near the critical state. Refractive index equip-
ment has been used for measurements on liquid and
solid argon, liquid methane, and liquid CF_4. Ultra-
sonic apparatus has been used for an extensive mapping
of absorption of sound near the consolute point in a
binary liquid system. During the period covered by
this grant, the program has resulted in 12 publications
in the open literature, one presentation at an inter-
national meeting, and assorted papers, seminars, and
informal contributions.

124

California Inst. of Tech. Antenna Lab., Pasadena.

THEORY OF THE SCATTERING OF ELECTROMAG-
NETIC WAVES BY IRREGULAR INTERFACES, by K.
M. Mitzner. Jan. 1964, 126p. incl. diagrs. refs.
(Technical rept. no. 30) (AFOSR-64-0802) (AF 49-
(638)1266) AD 436811   Unclassified

Two problems involving electromagnetic scattering
from irregular interfaces are treated, both determin-
istic and statistical irregularities being considered.
First, reflection of a partially polarized plane wave
from a plane interface with large irregularities is
studied using geometrical optics. Matrix transforma-
tions relating incident and reflected waves are ob-
tained for reflection from a single specular point and
from an extended area containing many independent
reflectors. The properties of a wave reflected from
a diffusely illuminated rough interface are found, and
these results are used to study reflection noise reduc-
tion when a polarization-sensitive detector viewing near
the Brewster angle is used in infrared temperature
measurements. Second, the method of small perturba-
tions is used to study scattering of an arbitrary com-
pletely polarized wave from an irregular interface of
general underlying shape. The irregularities are re-
placed by equivalent surface currents and then the field
in space is found using the dyadic Green's functions of
the unperturbed problem. The results obtained are
valid when the irregularity has small slope and ampli-
tude small compared to the wavelength and local radii
of curvature.

125

California Inst. of Tech. Antenna Lab., Pasadena.

MICROWAVE INTERACTION WITH BOUNDED
GYROELECTRIC PLASMAS, by E. R. Nagelberg.
Apr. 1964, 105p. incl. diagrs. refs. (Technical rept.
no. 31) (AFOSR-64-0803) (AF 49(638)1266)
AD 437672   Unclassified

The interaction of microwaves with gyroelectric
plasmas of finite extent was investigated, particularly
those having cylindrical or spherical boundaries. Within
the latter class of problems, only those involving the
axially magnetized column with circular cross section
are amenable to rigorous analysis. It was found that
one of the important effects of the anisotropy is to induce
changes in the polarization of the scattered field result-
ing from interaction with an obliquely incident plane
wave. As a means of solving problems which involve
uniform but arbitrarily directed magnetization, the
perturbation theory of microwave interaction in which
the static magnetic field is regarded as a small per-
turbation of the isotropic plasma was developed. The
field equations are derived for all orders but only those
of first order, linear in the magnitude of the static
magnetic field, are solved. (Contractor's abstract,
modified)

126

California Inst. of Tech. Antenna Lab., Pasadena.

ON THE THEORY OF NOISE-LIKE ELECTROMAG-
NETIC FIELDS OF ARBITRARY SPECTRAL WIDTH,
by A. D. Jacobson. June 1964, 214p. (Technical rept.
no. 32) (AFOSR-64-0804) (AF 49(638)1266)
AD 600454   Unclassified

Attention is restricted to fields whose random fluctua-
tions result exclusively from the chaotic nature of the
source. The theory is expressed in terms of the second
order moment of the field vector; hence, it is a tensor
theory. The principal field quantity, the dyadic field
spectral density (DFS), is interpreted from both a
statistical and a physical standpoint. In particular, a
statistical analysis of partial polarization is presented
with the aim of providing a physical interpretation of
the polarization of a quasi-monochromatic field. The
differential equations that govern the behavior of the
DFS are derived in the presence of a source, in a
source free region and in a generalized dielectric
medium. Boundary conditions are derived for the DFS
at a dielectric interface, at a perfectly conducting inter-
face, and at infinity. The differential equations are
integrated for various cases with the aid of the dyadic
Green's function. The resulting integral representation
for the DFS is employed to analyze an experiment that
involves the measurement of a partially polarized, in-
coherent, discrete radio star by means of a two-ele-
ment radio interferometer.

127

California Inst. of Tech. Antenna Lab., Pasadena.

ELECTROMAGNETIC RADIATION IN THE PRESENCE
OF MOVING SIMPLE MEDIA, by K. S. H. Lee and C.
H. Papas. [1964] [5]p. (Technical rept. no. 33)
(AFOSR-65-0391) (AF 49(638)1266) AD 612594
Unclassified

Also published in Jour. Math. Phys., v. 5: 1668-1672,
Dec. 1964.

A method is presented for calculating the influence of a
homogeneous, isotropic, nondispersive dielectric
medium moving at uniform velocity with respect to an
arbitrary electromagnetic source. The relative motion
between the source and the medium is specified by
stating that the rest frame K of the source moves at a
uniform velocity v with respect to the rest frame K' of
the medium and vice versa. The differential equation
for the potential 4-vector in K is derived and then
solved by Green's function technique. The case where
the source is an oscillating dipole is calculated in detail.

128

California Inst. of Tech. Antenna Lab., Pasadena.

ON THE DOPPLER EFFECT IN A MEDIUM, by K. S.
H. Lee. Dec. 1963, 88p. (Technical rept. no. 29)
(AFOSR-5367) (AF AFOSR-63-70) AD 426779
Unclassified

The problem of calculating the frequency of the wave
scattered by a body moving in a medium is formulated
from field-theoretic considerations. The Doppler equa-
tion for a homogeneous dispersive medium is obtained
on the basis of the fact that the frequency and the wave
vector of a plane wave form a 4-vector. It is found that
the solutions of the Doppler equation can be classified
into two kinds. In one kind, the solutions are close to
the frequency of the incident wave. In the other kind
they appear near the poles of the refractive index of
the medium on the omega-axis. In the case of an iso-
tropic plasma, the monochromaticity of the incident
wave is shown to be preserved after the wave is scat-
tered by a moving body. However, in the case of a
magneto-active plasma, the scattered wave contains
more than one frequency for a monochromatic incident
wave. The physical interpretations of these frequencies
are given.

129

California Inst. of Tech. [Antenna Lab.] Pasadena.

[STUDIES OF ANTENNAS, PLASMAS, AND NON-
LINEAR COMPONENTS] by C. H. Papas. Final re-
view rept. Oct. 1, 1962-Sept. 30, 1963, 4p. (AFOSR-
J1343) (AF AFOSR-63-70) Unclassified

The program of research consisted of a theoretical
study of (a) the Doppler effect in dispersive, inhomo-
geneous, anisotropic media; (b) the propagation of
broad-band, noise-like electromagnetic waves; (c) the

scattering of electromagnetic waves at irregular
interfaces; (d) the interaction of electromagnetic waves
with bounded, anisotropic plasmas; and (e) the diffuse
reflection of electromagnetic radiation from a foggy
medium.

130

California Inst. of Tech. [Dept. of Electrical
Engineering] Pasadena.

PLASMA DYNAMICS, by R. W. Gould. Final rept.
Mar. 1, 1963-Oct. 15, 1964, 7p. (AFOSR-65-0422)
(AF AFOSR-63-412) Unclassified

Approximately half the effort of this investigation has
been involved in a theoretical study of MHD waves in
plasmas of cylindrical symmetry with boundaries taken
into account. The remainder has dealt with experiments
designed to check the theoretical results. Two experi-
mental techniques have been developed: (a) an impulse
technique for simultaneous study of plasma behavior
over a wide frequency range, and (b) a hydromagnetic
wave interferometer for ion density measurements.
These and other results are described.

131

California Inst. of Tech. Dept. of Electrical
Engineering, Pasadena.

EXPERIMENTAL STUDY OF COMPRESSIONAL
HYDROMAGNETIC WAVES, by D. G. Swanson. June
1963, 109p. (Technical rept. no. 1) (AFOSR-65-1202)
(AF AFOSR-63-412) Unclassified

Also published in Phys. Fluids, v. 7: 269-277, Feb.
1964. (AFOSR-64-1372; AD 444469)

An experiment is described in which a compressional
hydromagnetic wave is observed in a hydrogen plasma-
filled waveguide. The theory of a cool, partially
ionized, resistive plasma in a magnetic field is de-
scribed briefly and expressions are derived for the
dispersion relation and transfer function which include
both the propagation and attenuation constants as a func-
tion of frequency. Measurements of the cutoff frequency
are presented, which verify its linear dependence on
the magnetic field, and they show good agreement with
theory on the variation with the ion mass density. The
impulse response of the plasma is studied, transformed
into the frequency domain, and quantitative comparisons
are made with the theoretical transfer function to deter-
mine the degree of ionization, the resistivity and the
ion-neutral collision frequency.

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California Inst. of Tech. Dept. of Electrical
Engineering, Pasadena.

HYDROMAGNETIC WAVE BOUNDARY CONDITION
AND A SURFACE WAVE IN A PLASMA-FILLED

WAVEGUIDE, by D. G. Swanson. July 1964, 28p.
(Technical rept. no. 2) (AFOSR-65-1203) (AF AFOSR-
63-412)   Unclassified

The analysis of a magnetized plasma in a waveguide
with a dielectric sheath between the plasma and wave-
guide is considered. Within the limitations of the cold
plasma, effective dielectric tensor approach, the prob-
lem is solved exactly and a few illustrative computer
solutions for the behavior of the transverse wave number
are presented. Also, some approximate low frequency
expressions are derived for the effect of the dielectric
sheath. It is found that these solutions agree better
with experiment than do those where no sheath at all is
assumed, and appear adequate to account for all experi-
mental observations. For the case of a finite or thick
sheath, the solutions disagree with some other sheath
theories, however, in an area where no experimental
observations are yet reported. The dielectric sheath
also adds a surface wave to the group of hydromag-
netic waves, and the coupling between the surface wave
and the hydromagnetic waves is shown in certain fre-
quency regions. Orthogonality relations are given which
show that the surface wave and the hydromagnetic waves
are all mutually orthogonal.

133

California Inst. of Tech. [Div. of Chemistry and
Chemical Engineering] Pasadena.

APPARATUS FOR X-RAY DIFFRACTION STUDIES OF
CONFINED FLUIDS, by W. I. Honeywell, C. M.
Knobler and others. [1964] [4]p. (AFOSR-64-2518)
(AF 49(638)1273) AD 453788   Unclassified

Also published in Rev. Scient. Instr., v. 35: 1216-
1219, Sept. 1964.

An apparatus is described for studies of the x-ray dif-
fraction of liquids in the temperature range 80-300 °K
and at pressures up to 100 atm. The device is com-
patible with a commercial goniometer and is usable in
both Debye-Scherrer and parafocusing geometries.

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California Inst. of Tech. Graduate Aeronautical Labs.,
Pasadena.

THE ELECTRICAL CONDUCTIVITY OF SHOCK-
IONIZED ARGON. A REVIEW OF THE EXISTING EX-
PERIMENTAL RESULTS, by T. F. Zien. Sept. 1964
[14]p. incl. diagrs. table, refs. (AFOSR-64-1488)
(AF 49(638)1348) AD 461013   Unclassified

The results are reviewed of measurements by various
experimenters in the degree of ionization range 10^{-5}
$< \alpha < 5 \times 10^{-1}$, with initial pressures ranging from 0.1
mmHg up to 100 mmHg.

135

California Inst. of Tech. Graduate Aeronautical Labs.,
Pasadena.

EARTH-TO-MOON TRAJECTORIES WITH MINIMAL
ENERGY, by P. A. Lagerstrom and J. Kevorkian.
[1963] [12]p. (Publ. no. 582) (AFOSR-64-1323)
(AF AFOSR-62-256) AD 443148; AD 444137
                                    Unclassified

Also published in Jour. Mecanique, v. 2: 493-504,
Dec. 1963.

A special case is analyzed of the dynamics of an
object of negligible mass ('particle') whose trajectory
originates near a body of relatively large mass ('the
earth') and passes close to a body of relatively small
mass ('the moon'). The prior assumptions made were
those of the restricted three-body problem together
with the additional assumption $\mu <$ Im where μ is the
ratio of the moon's mass to the total mass of the sys-
tem. This problem is a singular perturbation problem,
and a generalized boundary-layer technique was previ-
ously used to derive asymptotic formulas uniformly
valid for a part of the trajectory which included
approach orbit and moon passage.

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California Inst. of Tech. Graduate Aeronautical Labs.,
Pasadena.

NUMERICAL ASPECTS OF UNIFORMLY VALID
ASYMPTOTIC APPROXIMATIONS FOR A CLASS OF
TRAJECTORIES IN THE RESTRICTED THREE-BODY
PROBLEM, by P. A. Lagerstrom and J. Kevorkian.
[1963] [30]p. incl. diagrs. tables. (Publ. no. 590)
(AF AFOSR-62-256) AD 454987   Unclassified

Presented at AIAA Astrodynamics Conf., New Haven,
Conn., Aug. 19-21, 1963.

Also published in Prog. Astronaut. and Aeronaut.,
v. 14: 3-33, 1963.

In previous papers the authors have discussed the theo-
retical aspects of uniformly valid asymptotic approxima-
tions for the motion of a particle in a trajectory originat-
ing near a body of relatively large mass (the earth)
and passing close to a body of relatively small mass
(the moon). It was shown that determination of the
orbit during and after moon passage to the lowest order
requires in principle the determination of a correction
term to the Keplerian solution for the approach orbit.
This correction term was expressed in terms of certain
integrals. The present paper summarizes these theo-
retical results. The relevant definite integrals are
evaluated numerically so that the motion during and
after moon passage can be explicitly related to the
initial conditions near the earth. Typical results are
exhibited in various graphs. The Keplerian integrals
for the motion during moon passage obtained by the
present first-order theory are compared with exact
values calculated numerically on an IBM 7094 for 27
orbits corresponding to a wide range of initial conditions
and three values of the mass ratio. As expected, the

comparisons indicate that the accuracy of the present theory improves as the mass ratio becomes smaller. The largest value of the mass ratio used is that for the actual earth-moon system.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

RESEARCH ON NONLINEAR PROBLEMS IN STRUC-TURAL DYNAMICS, by Y. C. Fung. Final rept. Nov. 1963, 8p. (AFOSR-J1224) (AF AFOSR-62-374) AD 424285 Unclassified

Research on nonlinear problems in structural dynamics is briefly summarized. Panel flutter was investigated to make a critical comparison between theory and experiment concerning the flutter of plates and shells in a supersonic flow. With the aim of formulating a realistic computing program to analyze panel flutter in aerospace vehicles, plausible simplifying assumptions are examined in the light of experimental results. Structural dynamics research was conducted to study the nonlinear problems of shell buckling, shell vibrations, and shell dynamic responses. Thin circular cylindrical shells and thin spherical shells were chosen as objects of study because they are classical problems of wide current interest and usefulness in the industry. Nonlinear features were emphasized.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

SUPERSONIC SEPARATED AND REATTACHING LAMINAR FLOWS: I. GENERAL THEORY AND APPLI-CATION TO ADIABATIC BOUNDARY LAYER-SHOCK WAVE INTERACTIONS, by L. Lees and B. L. Reeves. Oct. 4, 1963, 72p. incl. diagrs. refs. (Technical rept. no. 3) (AFOSR-64-0893) (AF AFOSR-63-54) AD 437687; AD 600097 Unclassified

Laminar boundary layer-shock wave interactions are studied in which the pressure rise generated in an external supersonic, inviscid flow is communicated upstream through the boundary layer, and thereby induces flow separation. An integral or moment method is used in which the first moment of momentum is employed, in addition to the usual momentum integral (zeroth moment). By this means the velocity and enthalpy profiled are characterized by a single independent parameter not explicitly related to the local static pressure gradient. This method itself is not new, but it turns out that its successful application to separated and reattaching flows hinges on the proper choice of the one-parameter family of velocity profiles utilized to represent the integral properties of the viscous flow. It is shown that the Stewartson reversed-flow profiles and their Cohen Reshotko analogues for flows with heat transfer have the qualitatively correct behavior; polynomials do not.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE ACCURACY OF APPLYING LINEAR PISTON THEORY TO CYLINDRICAL SHELLS. by H. Krumhaar. Mar. 1963, 28p. (AFOSR-4668) (AF AFOSR-63-352) AD 408387 Unclassified

The aerodynamic pressure acting on a circular cylindrical shell of infinite length in an air-flow parallel to the cylinder axis is studied. The shell is deformed by a harmonically oscillating standing wave of a sinusoidal pattern. Based upon the exact solutions, asymptotic expansions are developed for the aerodynamic pressure. In this manner the accuracy of the linear piston theory approximation, when applied to cylindrical shells, is investigated. Furthermore improved approximations can be obtained from these asymptotic expansions.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE BUCKLING OF CLAMPED SHALLOW SPHERICAL SHELLS UNDER UNIFORM PRESSURE, by R. R. Parmerter. Nov. 1963, 97p. (AFOSR-5362) (AF AFOSR-63-352) AD 429764 Unclassified

The problem of the buckling of clamped spherical shells under uniform external pressure is examined. A theoretical study is carried out to determine if asymmetrical modes participate in the snap-through process. It is shown that asymmetrical buckling does occur in a certain range of a geometric parameter, at loads which are significantly less than those predicted from symmetrical theory. Additional effects can be expected if the shell has symmetrical or asymmetrical imperfections, however, the present study considers only the perfect shell. Experiments were carried out with copper shells fabricated by an electroforming process. The initial imperfections in the test specimens were of the order of 1/10 of the thickness. The buckling loads of these shells exceeded the loads which have previously been reported by as much as a factor of two at higher values of the geometrical parameter. Good agreement is found between theory and experiment, and with the recently published asymmetrical theory of Huang.

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California Inst. of Tech. [Graduate Aeronautical Labs.] Pasadena.

SOME RECENT CONTRIBUTIONS TO PANEL FLUTTER RESEARCH, by Y. C. Fung. [1963] [12]p. incl. illus. diagrs. refs. (Publ. no. 548) (AFOSR-64-0111) (AF AFOSR-63-352) AD 430663 Unclassified

Presented at Thirty-first annual meeting of the IAS, New York, Jan. 21-23, 1963.

Also published in AIAA Jour., v. 1: 898-909, Apr. 1963.

With the objective of formulating a realistic computing program to analyze panel flutter in aerospace vehicles, plausible simplifying assumptions are examined in the light of experimental results. It is shown that in certain areas very simple analysis yields respectable results, whereas in other areas great elaboration is necessary to obtain an accurate prediction. In particular, the role played by the boundary layer flow is discussed. The attenuation and phase shift in pressure-deflection relationship caused by the boundary layer can become important under certain circumstances. Examples are given which show that the boundary layer greatly stabilizes flat plates in a transonic or low supersonic flow and circular cylindrical shells at higher Mach numbers.

142

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE ACCURACY OF LINEAR PISTON THEORY WHEN APPLIED TO CYLINDRICAL SHELLS, by H. Krumhaar. [1963] [2]p. (AFOSR-64-0113) (AF AFOSR-63-352) AD 430664   Unclassified

Also published in AIAA Jour., v. 1: 1448-1449, June 1963.

A short survey of an investigation of the accuracy of the linear piston theory when applied to cylindrical shells is given. (Contractor's abstract)

143

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE EFFECT OF WALL ELASTICITY AND SURFACE TENSION ON THE FORCED OSCILLATIONS OF A LIQUID IN A CYLINDRICAL CONTAINER. PART I. ANALYSIS, by P. Tong and Y. C. Fung. Oct. 1964 [36]p. incl. diagr. refs. (AFOSR-64-2019) (AF AFOSR-63-352) AD 608548   Unclassified

The stability of a fluid contained in a circular cylindrical tank with a flat, flexible bottom under a periodic axial excitation was studied. An analytical difficulty for the solution of the linearized equations in the form of infinite series was discussed. A variational approach is formulated. An approximate solution results in a pair of coupled ordinary differential equations with periodic coefficients. A method of handling the stability of the solutions of such a system of equation is presented. Numerical results will be discussed in a later article.

144

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

LARGE ELASTIC DEFORMATION OF THIN CYLINDRICAL TUBES, by J.-s. Lee. Oct. 1964, 46p. incl.

diagrs. tables. (AFOSR-64-2020) (AF AFOSR-63-352) AD 608546   Unclassified

Considered is an elastic, incompressible, isotropic material whose constitutive law is specified by a strain-energy function W which is a function of two strain invariants I_1 and I_2. In the mathematical theory of large deformations of axially symmetrical elastic membranes, the governing equations are a set of nonlinear ordinary differential equations. Three types of deformation of thin circular cylindrical rubber tubes are discussed. In the first type a rubber tube is deformed into another by simultaneous inflation and extension of the tube. The second type of deformation considered is a stretching of the tube without internal pressure. The third type is a tube inflated by internal pressure, with or without a change in total length or end diameter. In these two types the deformed tube is a curved surface of revolution; the analysis is more complicated, and the calculations are restricted to Mooney-Rivlin materials.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

NONLINEAR PROBLEMS IN STRUCTURAL DYNAMICS, by Y. C. Fung. Final rept. Oct. 15, 1964, 10p. (AFOSR-64-2228) (AF AFOSR-63-352)
                                              Unclassified

Research in the areas of aeroelasticity, panel flutter, shell instability, shock and vibrations of mechanical and aeroelastic systems, and damping mechanism is discussed.

146

California Inst. of Tech. [Graduate Aeronautical Labs.] Pasadena.

[INVESTIGATION IN FLUTTER OF THIN WALL CIRCULAR CYLINDER OF FINITE LENGTH IN SUPERSONIC STREAMS] Untersuchungen über das Flattern eines dünnwandigen, kreisrunden Zylinders endlicher Länge in Überschallstromung, by H. Krumhaar. [1963] [9]p. incl. diagrs. refs. (AFOSR-65-2473) (AF AFOSR-63-352) AD 629625
                                              Unclassified

Also published in Jahrbuch der WGLR, 1963, p. 306-314.

A short review is given of flutter investigations for a thin cylindrical shell of finite length in a supersonic air stream with restriction to axisymmetrical modes. Using the linearized Timoshenko shell equations and the linear piston theory, the flutter problem is reduced to a nonself-adjoint, ordinary eigen-value problem. This problem is solved without further approximations. Using these results flutter boundaries for the cylinder are derived. The reliability of the underlying physical assumptions can then be investigated by comparison with experimental results.

147

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

SOME THEORETICAL AND EXPERIMENTAL RESULTS CONCERNING THE GROWTH OF BOUNDARY LAYERS IN PLASMA ACCELERATORS, by F. E. Marble and E. E. Zukoski. Final rept. Feb. 1963, 32p. incl. diagrs. tables, refs. (AFOSR-4627) (AF 49(638)758)
Unclassified

The work accomplished to date is summarized under 3 headings: (1) Analysis, (2) Ionization rates in noble gases, and (3) Gas phase and surface phenomena affecting the electrical properties of potassium-seeded argon.

148

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

NON-EQUILIBRIUM ELECTRICAL CONDUCTIVITY IN A SEEDED PLASMA, by E. E. Zukoski, T. A. Cool, and E. G. Gibson. Apr. 1964, 67p. (AFOSR-64-0648) (AF 49(638)1285) AD 602683 Unclassified

Measurements of conductivity were made in a plasma composed of argon seeded with potassium vapor. The gas temperature was $2000°K$; the pressure, one atmosphere; the potassium concentration was between 0.22 and 0.80 mol-%, and the current density was between 1 and 80 amp/sq cm. Conductivity values were calculated from a two-temperature model in which the energy dependence of the cross sections and radiation losses from the plasma are taken into account. The theoretical and experimental values are in excellent agreement.

149

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

ABSOLUTE INTENSITY MEASUREMENTS AND GAS EMISSIVITIES AT ELEVATED TEMPERATURES AND PRESSURES. Final technical rept. Nov. 15, 1962-Dec. 31, 1963, 4p. (AFOSR-J1337) (AF AFOSR-63-71) AD 426569 Unclassified

Similarity groups were derived for multicomponent, reacting gas mixtures with radiative energy transport. Resulting relations were used to consider the feasibility of scaling for flow processes with radiative energy transport under highly simplified conditions. Oscillator strength and spectroscopic temperature determinations on OH in a shock tube were carried out. The shock tube study of the $2.7-3.2 \mu$ band of water vapor, was continued. The purpose of this study was simultaneous measurement of the absolute intensity of the band both in emission and in absorption at $1000°K$. This objective was accomplished and emission measurements were made at $3000°K$. Extensive data were collected on the absolute GF numbers of several lines of neutral and ionized chromium carbonyl. Data on the relaxation times for excitation and ionization of chromium were also obtained in these experiments. Electronic tempera-

tures for Cr I and Cr II behind reflected shock waves were measured.

150

California Inst. of Tech. [Guggenheim Jet Propulsion Center] Pasadena.

SHOCK TUBE MEASUREMENTS OF THE ABSORPTION OSCILLATOR STRENGTH FOR THE $OH^2\Sigma - {}^2\pi$ ELECTRONIC BAND SYSTEM, by R. Watson. [1964] [7]p. (AFOSR-64-1040) (AF AFOSR-63-71) AD 441493
Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 4: 1-7, Jan./Feb. 1964.

Previous shock tube measurements of the oscillator strength for the $OH^2\Sigma - {}^2\pi$ band system made in this Laboratory have been corrected. Light scattering in the absolute intensity calibration has been eliminated and a continuous flushing technique was used for preparation and introduction of the water vapor-argon test gas mixture into the shock tube. The experimental technique remains essentially the same as in the earlier studies: hot gas samples of OH at $3100-3500°K$ were produced by the dissociation of H_2O behind the reflected shock, and the linear rate of increase of absolute spectral intensity in the transparent gas region was measured by monitoring emission from axial observations in the shock tube. The absorption electronic f-number for the ${}^2\Sigma - {}^2\pi$ band system has been determined from the shock tube measurements as $(3.9 + 0.9) \times 10^3$.

151

California Inst. of Tech. Palomar Observatory, Pasadena.

ON THE ACCELERATION OF PARTICLES IN SHOCK FRONTS, by E. Schatzman. [1963] [16]p. incl. diagrs. tables. (AFOSR-2249) (AF 49(638)21) AD 423427
Unclassified

Also published in Ann. Astrophys., v. 26: 234-249, May-June 1963.

Charged particles can be accelerated in a perpendicular magnetohydrodynamic shock wave. The scattering of particles by the clumpiness of the magnetic field provides the statistical mechanism which is at the origin of the energy spectrum. The energies which can be obtained are quite high, even for weak shocks, but the stronger is the shock, the larger is the number of accelerated particles. It is possible to derive the energy spectrum, which obeys to a power law, deeply related to the nature of the clumps, which can be those found in collision-free shocks. The conditions for acceleration (injection in the accelerating process) are the same as those for the existence of the clumps in collision-free shocks. These results are applied to surface nuclear reactions and provide a good explanation of He^3 in 3 Cen A and Li in lithium stars. (Contractor's abstract)

152

California Inst. of Tech. Palomar Observatory, Pasadena.

THE ULTRAVIOLET SPECTRUM OF 3 CENTAURI A, by J. Jugaku and W. L. W. Sargent. [1963] [7]p. incl. tables, refs. (AFOSR-64-0281) (AF 49(638)21) AD 431085   Unclassified

Also published in Astrophys. Jour., v. 138: 90-96, July 1, 1963.

A list of identifications is given for 65 lines measured on a Radcliffe coudé spectrogram of the region $\lambda\lambda$ 3120-3700 in the spectrum of 3 Cen A (B4p). Lines of Mn II are present; the resonance Be II doublet λ3130 is absent. Relative abundances or upper limits for Be and the iron-peak elements are derived by comparison with ν Lyr (A0 V). The abundance ratio Mn:Fe is normal in 3 Cen A; that of Ni:Fe is a little low; the abundance of Be is less than, or equal to, that in ν Lyr while the abundance ratio Cr:Fe is lower in 3 Cen A than in ν Lyr by a factor of more than about 40. The possible relationship between 3 Cen A and the magnetic peculiar A stars is discussed in the light of these new results. (Contractor's abstract)

153

California Inst. of Tech. Palomar Observatory, Pasadena.

METAL ABUNDANCES IN THE SUBGIANT ζ HERCULIS AND THREE OTHER dG STARS, by H. L. Helfer, G. Wallerstein, and J. L. Greenstein. [1963] [21]p. incl. diagrs. tables, refs. (AFOSR-64-0594) (AF 49(638)-21) AD 434315   Unclassified

Also published in Astrophys. Jour., v. 138: 97-117, July 1, 1963.

Abundances for 32 elements are obtained for the G stars ζ Her, 99 Her, β Com, and 85 Peg. ζ Her, a high-velocity subgiant with well-determined mass, possesses solar metal abundance; the previously re-ported metal deficiency of 85 Peg and 99 Her and the normal metal content of β Com are substantiated. A search for representative unblended lines of 18 addi-tional elements yielded little additional information, only that these elements were not strongly overabundant. The relative excess of α-elements in 85 Peg is con-firmed, sulfur now being added to the list of observable α-elements. The manganese deficiency in the metal-poor stars is well established. Abundances of many elements of atomic weight heavier than the iron group of elements have been obtained; generally their abund-ance relative to iron is about the same as in the sun. In both metal-deficient stars, samarium appears over-abundant, and there is a possibility that molybdenum and ruthenium may be overabundant in 85 Peg. (Con-tractor's abstract)

154

California Inst. of Tech. Palomar Observatory, Pasadena.

THE 1960 MINIMUM OF R CORONAE BOREALIS, by C. Payne-Gaposchkin. [1963] [22]p. incl. diagrs. tables, refs. (AFOSR-64-0596) (AF 49(638)21) AD 434409   Unclassified

Also published in Astrophys. Jour., v. 138: 320-341, Aug. 15, 1963.

The spectrum of R Coronae Borealis at maximum is that of a supergiant carbon star of spectral class equiva-lent to F7. As the star drops to minimum, veiling of the absorption spectrum is followed by the appearance of a very rich, bright-lined spectrum with relatively sharp lines, which fades exponentially, and also by the appear-ance of several strong, broad, bright lines, which per-sist with little change for some time and later fade abruptly. The average conditions in the layers that produce the rich, bright-lined spectrum correspond to $\theta = 1.02$, $\log P_e = -2.0$, somewhat lower in tempera-ture than the photosphere and at much lower electron pressure. The broad, bright-lined spectrum shows the H and K lines, the D lines, and a line at 3889A which is ascribed to He I. The changes during the minimum are ascribed to a slow contraction of the envelope, leading to increased density and the deposition of carbon black, which is responsible for the large changes in brightness and for the reddening of the star's light. The rich, bright-lined spectrum is neither obscured nor reddened and is ascribed to an expanding chromosphere that fades progressively. The broad, bright-lined spectrum is ascribed to material which is ejected with high velocity in connection with the initial contraction of the envelope and is collisionally excited when it interacts with a cir-cumstellar cloud. The other cool stars of R Coronae class behave in a similar manner and their rate of variation is shown to be related to their photospheric temperatures. (Contractor's abstract)

155

California Inst. of Tech. Palomar Observatory, Pasadena.

PREDICTED FLUXES AND LINE INTENSITIES IN LATE-TYPE MODEL ATMOSPHERES, by R. Cayrel and J. Jugaku. [1963] [66]p. incl. diagrs. tables, refs. (AFOSR-64-1397) (AF 49(638)21) AD 444001   Unclassified

Also published in Ann. Astrophys., v. 26: 495-560, Nov.-Dec. 1963.

The determination of the chemical composition of stars requires the knowledge of the dependence of stellar line intensities and colors on temperature, surface gravity and metal/hydrogen ratio. This dependence is often obtained with neglecting the photospheric structure which is replaced by one representative point (single-layer approximation). In this paper this dependence is tabulated by model atmosphere computations. A series of model atmospheres, representating main-sequence stars in the temperature range theta-effective = 0.7 to 1.4, was computed with metal/hydrogen ratios from 0.1 to 1.0 times that in the sun. The predicted

emergent fluxes in the continuous spectra are given. The strengths of weak lines are tabulated for eight elements for various excited levels and wavelengths. The various factors affecting the strengths of typical metallic lines when the metal abundance is decreased are discussed in detail. Approximation formulae are given. Theoretical luminosity and blanketing effects on the photoelectric B and V colors are also computed. (Contractor's abstract)

156

California Inst. of Tech. [Palomar Observatory] Pasadena.

THE CHEMICAL COMPOSITION OF TWO CH STARS, HD 26 AND HD 201626, by G. Wallerstein and J. L. Greenstein. [1964] [17]p. (AFOSR-64-1970) (AF 49-(638)21) AD 452344   Unclassified

Also published in Astrophys. Jour., v. 139: 1163-1179, May 15, 1964.

The high-velocity CH stars appear to be deficient in metals but rich in carbon and heavy elements. By a comparative curve-of-growth analysis using the G8 III star epsilon Virginis as a standard, it was found that the CH stars, HD 26 and HD 201626, are metal-poor by factors of 5 and 30, respectively. Both stars show a carbon-to-iron ratio 5 times higher than epsilon Vir. There is no evidence for the presence of C13. In addition, both show an excess of Ba, La, Ce, and Nd with respect to Fe, by factors of about 20. Eu is enhanced by only a factor of 5 in HD 26, and by less than 2 in HD 201626. Except for their general metal deficiency these stars have relative abundances of C:Fe:Ba very similar to the population I Ba II star, HD 46407.

157

California Inst. of Tech. Palomar Observatory, Pasadena.

THE NEAR INFRARED SPECTRUM OF NOVA HERCULIS 1963, by B. Baschek. [1964] [6]p. (AFOSR-64-1971) (AF 49(638)21) AD 452503   Unclassified

Also published in Publ. Astronom. Soc. Pacific, v. 76: 22-27, Feb. 1964.

Ten infrared spectrograms of Nova Herculis 1963 were obtained with the coude spectrograph of the 100-in. telescope on Mount Wilson between Feb. 14 and July 5, 1963, covering the interval between the 9th and the 149th day after the outburst of the nova. The spectra, taken on ammoniated Eastman I-N emulsion, with the 16-in. camera at a dispersion of 40 A/mm, and with the 8-in. camera at 80 A/mm are listed. The stellar spectra were widened to 0.2mm or more on the plate. Tracings were made on an intensity scale using strip or wedge calibration. The nova's continuous spectrum cannot be seen after May 10. Absorption lines of the principal, diffuse enhanced, and Orion system are found before Apr. 5, mostly for H i, He i, N i, and O i. They are listed with wavelengths measured relative to superposed nearly atmospheric lines.

As a measure of their strength, the maximum absorption with respect to a local continuum and the total half-width are given.

158

California Inst. of Tech. Palomar Observatory, Pasadena.

THE EFFECT OF SELF ABSORPTION OF BALMER-LINE RADIATION IN GASEOUS NEBULAE DUE TO HYDROGEN ATOMS IN THE 2s STATE, by E. R. Capriotti. [1964] [9]p. incl. diagr. tables. (AFOSR-64-2300) (AF 49(638)21) AD 452247   Unclassified

Also published in Astrophys. Jour., v. 140: 632-637, Aug. 15, 1964.

This paper describes an investigation of the effect of self-absorption due to hydrogen atoms in the 2s state. The results indicate that for equivalent optical depths in the 2p yields (3s, 3d) and the 2s yields 3p lines, the effects of absorption from the 2s level are greater than the effects of absorption from the 2p level.

159

California Inst. of Tech. Palomar Observatory, Pasadena.

ON A RECENT ABUNDANCE ANALYSIS OF 7 SEX-TANTIS, by W. L. W. Sargent, L. Searle, and G. Wallerstein. [1964] [3]p. (AFOSR-65-1075) (AF 49-(638)21) AD 620493   Unclassified

Also published in Astrophys. Jour., v. 139: 1015-1017, Apr. 1, 1964.

In an abundance analysis of the high-velocity A star, 7 Sextantis, by Wallerstein, Stone, and Williams (1962), one of the conclusions reached was that the He:H ratio in 7 Sex is about 10 and that C is overabundant by a factor of about 20. In the present note this is shown to be inaccurate and that 7 Sex has a normal composition in every respect. It is postulated that this inaccuracy possibly arose through adopting too low a temperature for 7 Sex.

160

California Inst. of Tech. Palomar Observatory, Pasadena.

STUDIES OF THE PECULIAR A STARS. II. THE SILICON-ABUNDANCE ANOMALY, by L. Searle and W. L. W. Sargent. [1963] [20]p. incl. diagrs. tables, refs. (AFOSR-65-2154) (AF 49(638)21) AD 629036
                    Unclassified

Also published in Astrophys. Jour., v. 139: 793-812, Apr. 1, 1964.

Equivalent widths of the Si II lines, λ 4128 and λ 4130, and the Mg II line, λ 4481, have been measured on 10 A/mm spectrograms of 31 Ap stars and 5 A- and

B-type normal stars. Both the Si II and Mg II lines are quite insensitive to temperature and electron pressure and behave almost identically in normal A- and B-type stars. There are large variations in the relative strengths of the Si II and Mg II lines in the Ap stars which is interpreted as abundance variations, both in the Si/H ratio and the Mg/H ratio, from star to star. Balmer-line profiles have also been measured; those of the Ap stars do not differ systematically from those of normal stars of the same color. Published U - B and B - V colors and the Balmer-line profiles have been used to deduce representative values of θ and log P_e for each star, and abundance ratios Si/H and Mg/H derived. The Mn stars have normal abundances of both Si and Mg, while the stars in which λ 4200 of Si II is strong are overabundant in Si by factors ranging from about 10 to about 60; in the λ 4200-Si stars, the abundance ratio Si/Mg has an approximately constant value of about 60 times normal. All these stars have B - V ≤ 0.0 but otherwise no dependence of Si abundance on color. The redder Ap stars, having strong lines of Eu, Cr, and Sr, are slightly overabundant in Mg and have Si abundances varying from 10 times normal to 10 times less than normal. Equivalent widths or upper limits, have also been measured for the He I line, λ 4471, and for C II, λ 4267, which behave in a similar manner in normal stars. In the Mn stars the lines are normal or slightly weak for the color, but in the λ 4200-Si stars both C II and He I are very weak.

161

California Inst. of Tech. Palomar Observatory,
Pasadena.

THE ISOTOPE RATIO C^{12}/C^{13} IN A COMET, by A. Stawikowski and J. L. Greenstein. [1964] [14]p. incl. illus. diagr. tables, refs. (AFOSR-65-0396) (AF 49-(638)1323) AD 612579   Unclassified

Also published in Astrophys. Jour., v. 140: 1280-1291, Oct. 1, 1964.

High-resolution spectra of Comet Ikeya (1963a) show the $C^{12}C^{13}$ (1,0) band at λ 4745 with measurable strength. Its intensity has been measured and compared with the intensity of two unresolved-triplet, rotational lines of $C^{12}C^{12}$ (1,0). The structure of the isotope band has been computed to obtain the number of lines forming the observed head. From the theory of the excitation of comet lines by resonance fluorescence, the isotope ratio C^{12}/C^{13} is derived as 70 ± 15. Solar-absorption features, although included, modify the excitation pattern of the C_2 lines only slightly, unlike the CN band which has strongly deficient solar radiation. A feature at λ 4752 appears near $C^{13}C^{13}$ (1, 0). Its strength is too great to be compatible with $C^{12}/C^{13} \approx 70$, requiring an unacceptably low value. A discussion as to whether $C^{12}C^{13}$ can be de-excited by pure rotation, unlike the homonuclear C^{12} molecules, leads to no definite conclusion since the dipole moment of $C^{12}C^{13}$ is unknown. It is believed that λ 4752 is largely affected by a blend with NH_2. Another slight blend, at λ 4745, may require a slightly higher isotope ratio C^{12}/C^{13}. The C^{12}/C^{13} ratio is near that on the earth. Some implications for the early history of the solar system are drawn. If

the solar C^{12}/C^{13} ratio proves indeed to be very high the cometary C^{13} could have been produced by neutron irradiation.

162

California Inst. of Tech. Quantum Electronics Lab.,
Pasadena.

STUDIES ON OPTICAL SCATTERING AS A TECHNIQUE FOR PLASMA DIAGNOSTICS, by S. E. Schwarz. May 1964, 105p. incl. illus. diagrs. refs. (Scientific rept. no. 1) (AFOSR-64-1143) (AF 49(638)1322) AD 603738   Unclassified

When a pulse of intense light from a giant-pulse laser passes through a plasma, a very small fraction of the light is scattered out of the beam as a result of ('Thomson') scattering by free electrons. Under suitable conditions the intensity of the scattered light is proportional to the density of free electrons, while its spectral distribution is related to the velocity distribution of the free electrons through the Doppler formula. Theoretical considerations are discussed. An apparatus for conducting scattering experiments was constructed. Measurements conducted at various times in the development of an afterglow plasma indicate Doppler broadening of the scattered light; the broadening disappears as the electrons cool during the first three microseconds of the afterglow. Measurements of electron density as a function of time were made in the afterglow. Two unexpected laser-plasma interactions were observed. The first is designated as 'induced plasma luminosity' and the second as 'giant scattering'. Both effects appear to be related to the presence of hydrocarbon impurities in the gas.

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California Inst. of Tech. Quantum Electronics Lab.,
Pasadena.

AN ANALYSIS OF PERTURBED CONFOCAL RESONATORS, by J. F. Asmus. Sept. 1964, 141p. (Scientific rept. no. 3) (AFOSR-64-2074) (AF 49(638)1322) AD 609769   Unclassified

An analytic technique is developed for computing mode functions and associated diffraction losses of perturbed multimode optical resonators. It is based upon a consistent field formulation of resonance in an open two-mirror system. To illustrate the method the theory of confocal resonators is extended to include configurations differing from the confocal case by small geometrical perturbations. This involves computing and expanding a perturbed Green's function for such near confocal resonators. Diffraction losses for certain statistical and deterministic perturbations are computed and related to disturbances arising from an imperfect figure, polish or alignment of the mirrors. The design and construction of a stable laser spectrometer consisting of a single mode tuneable gas laser and a swept interferometer are described. Measurements of the diffraction losses of perturbed confocal resonators are found to be in agreement with the above analysis.

164

California Inst. of Tech. Seismological Lab., Pasadena.

ATTENUATION OF SHEAR WAVES IN THE UPPER
AND LOWER MANTLE, by R. L. Kovach and D. L.
Anderson. [1964] [10]p. incl. diagrs. table, refs.
(AFOSR-65-2917) (AF 49(638)1337) AD 612859
Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
1855-1864, Dec. 1964.

The attenuation of seismic waves is a direct measure
of the absorption due to nonelastic processes in the
earth. The well known difficulties in obtaining body wave
amplitude decrement data have been evoked by studying
the spectral ratios of multiple ScS and sScS phases
from two deep focus earthquakes recorded at near nor-
mal incidence. The average Q, for shear, in the mantle
is about 600 for the frequency range 0.015 to 0.07 cps.
Assuming that equal radiation occurs upwards and down-
wards from the source the average Q for the upper 600
km of the mantle is determined to be about 200 and
about 2200 for the rest of the mantle. The value for Q
at the base of the mantle is at least 5000 for shear
waves.

165

California Inst. of Tech. Seismological Lab., Pasadena.

INFERENCES ON CRUSTAL VELOCITIES AND
DENSITIES FROM P WAVE DELAYS AND GRAVITY
ANOMALIES, by F. Press and S. Biehler. [1964] [17]p.
incl. diagrs. tables, refs. (AFOSR-65-2919)
(AF 49(638)1337) AD 612216   Unclassified

Also published in Jour. Geophys. Research, v. 69:
2979-2995, July 15, 1964.

A correlation is demonstrated between P wave delays
and Bouguer gravity anomalies. For California data it
is given approximately by $(\Delta g) = 355 PD$ where (Δg) is
the Bouguer (slab equivalent) gravity change in milligals
and PD is the delay in seconds. The increases in P
wave delays and negative gravity anomalies associated
with topographic highs are manifestations of isostatic
adjustment. However, composition changes of the type
implied by empirical velocity-density relationships
cannot explain the gravity changes associated with P
wave delays in California batholiths. One way to re-
concile the discrepancy is to postulate velocity reversals
in the batholith. A thermal argument shows that
anomalously high temperatures are likely to occur
under the Sierra Nevada because of the unusually large
thickness of batholithic rock. Velocity reversals under
such circumstances are plausible. (Contractor's
abstract)

166

California Inst. of Tech. [Seismological Lab.] Pasadena.

THEORETICAL AND OBSERVED ACOUSTIC-GRAVITY
WAVES FROM EXPLOSIVE SOURCES IN THE ATMOS-

PHERE, by D. G. Harkrider. [1964] [26]p. incl.
diagrs. refs. (AFOSR-65-2920) (AF 49(638)1337)
AD 612217   Unclassified

Also published in Jour. Geophys. Research, v. 69:
5295-5321, Dec. 15, 1964.

A matrix formulation is used to derive the pressure
variation for acoustic-gravity waves from an explosive
source in an atmosphere modeled by a large number of
isothermal layers. Comparison of theoretical and ob-
served barograms from large thermonuclear explosions
leads to the following conclusions: (1) The major features
on the barogram can be explained by the superposition
of four modes, (2) different parts of the vertical tem-
perature structure of the atmosphere control the relative
excitation of these modes, (3) a scaled point source is
sufficient to model thermonuclear explosions, (4) the
observed shift in dominance of certain frequencies with
yield and altitude can be explained by means of the
empirical scaling laws derived from the direct wave
near the explosion, and (5) out to 50 degrees from the
source, the observed variation of amplitude with dis-
tance can be accounted for by geometrical spreading over
a spherical surface.

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California Inst. of Tech. Seismological Lab., Pasadena.

DETERMINATION OF SOURCE PARAMETERS OF
EXPLOSIONS AND EARTHQUAKES BY AMPLITUDE
EQUALIZATION OF SEISMIC SURFACE WAVES. 1.
UNDERGROUND NUCLEAR EXPLOSIONS, by M. N.
Toksöz, A. Ben-Menahem, and D. G. Harkrider.
[1964] [12]p. incl. diagrs. tables, refs. (AFOSR-65-
2922) (AF 49(638)1337)   Unclassified

Also published in Jour. Geophys. Research, v. 69:
4355-4366, Oct. 15, 1964.

A method of determining the source parameters of
explosions and earthquakes from the amplitude spec-
trums of seismic surface waves is described. The
method, called amplitude equalization, involves the
correction of the ground displacement spectrum for
the propagation effect. This is accomplished by multi-
plying it numerically with the inverse of the frequency
response of the layered medium. The result is the
amplitude spectrum of the source function, which may
be interpreted by itself or jointly with the initial phase
spectrum to determine the source-time variation. The
spectrums of the Rayleigh waves from underground
nuclear explosions are compared and the source-time
function is interpreted using the amplitude equalization
method. The time variation of the pressure pulse at the
boundary of the elastic zone is found to be of the form

$p(t) = P_0 t e^{-\eta t}$, where η is a parameter which depends
on the yield of the explosion and on the medium. For
the events studied, the breadth of the pulse increased
(η decreased) with the yield of the explosion. (Con-
tractor's abstract)

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California Inst. of Tech. Seismological Lab., Pasadena.

SPECTRAL RESPONSE OF AN ELASTIC SPHERE TO
DIPOLAR POINT SOURCES, by A. Ben-Menahem.
[1964] [18]p. (AFOSR-65-2923) (AF 49(638)1337)
AD 612214   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
1323-1340, Oct. 1964.

A stratified elastic sphere is excited by an harmonic
dipolar source of arbitrary orientation and depth. The
total field is expanded in series of vector spherical
harmonics and then condensed into a convenient form
of a displacement dyadic. The Haskell-Gilbert matrix
method is employed to obtain the radial factor of the
displacements for a multilayered sphere. The depend-
ence of the field on the azimuth angle and the fault ele-
ments is obtained for the case of a double-couple at
depth. Expressions are also developed for the radiation
pattern of surface waves over a spherical stratified
earth. (Contractor's abstract)

169

California Inst. of Tech. Seismological Lab., Pasadena.

RADIATION PATTERNS OF SEISMIC SURFACE
WAVES FROM BURIED DIPOLAR POINT SOURCES IN
A FLAT STRATIFIED EARTH, by A. Ben-Menahem
and D. G. Harkrider. [1964] [16]p. incl. diagrs. tables,
refs. (AF 49(638)1337) AD 445224   Unclassified

Also published in Jour. Geophys. Research, v. 69:
2605-2620, June 15, 1964.

Explicit compact expressions were obtained for the far
displacement field of Rayleigh and Love waves generated
by force configurations which served to simulate shear-
type faults with arbitrary dip and slip. The medium
transfer functions for dipolar sources were computed
for a Gutenberg flat continental earth model with 23
layers. These were then used to obtain universal
radiation pattern charts for couple- and double-couple-
type sources at various depths over the period range
50 to 350 sec. It was demonstrated by means of few
typical examples that the radiation patterns of Rayleigh
waves may depend strongly on the depth of the source,
and unlike the fundamental Love mode may be rather
sensitive to small variations in frequency. For a given
source and frequency the radiation pattern may differ
considerably from one mode to another. (Contractor's
abstract)

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California Inst. of Tech. [Seismological Lab.] Pasadena.

SEISMIC SIGNAL ENHANCEMENT WITH THREE-
COMPONENT DETECTORS, by M. Shimshoni and S.
W. Smith. [1964] [8]p. (AF 49(638)1337)
AD 612215   Unclassified

Also published in Geophysics, v. 29: 664-671, Oct. 1964.

The time-averaged cross-product of vertical and radial
components of ground motion is multiplied by the
original signal producing a function of ground motion in
which rectilinearly polarized motion is enhanced. This
provides some separation of seismic signals from noise
when both occupy the same frequency and velocity bands.
The vertical and radial motion is decomposed into its
Fourier components, and the parameters of an equiva-
ient ellipse are computed at each instant of time. The
eccentricity, major axis, and angle of inclination of the
ellipse provide criteria for identifying P and SV waves
of different velocities.

171

California Inst. of Tech. Seismological Lab., Pasadena.

STUDY OF FREE AND FORCED OSCILLATIONS OF
THE EARTH. Final progress rept. July 1-Sept. 30,
1963 [9]p. incl. diagr. (AF AFOSR-62-355)
AD 424117   Unclassified

Construction of the additional extensometer component
at the Lake Isabella station has been completed. The
new adit has a length of 125 ft; oriented perpendicular to
the original component. As in previous designs the
25-meter quartz extensometer standard is suspended
within a concrete trough. Piers in the form of 6 ft
lengths of 12-in. diam water well casing were cemented
into the rock to a depth of 5 ft for anchoring the fixed
end of the quartz standard and the transducer respec-
tively. The trough is covered to protect the quartz
tube and the transducers from dust and damage by
falling rock and reduce temperature variations. Near
the junction of the two tunnels a sealed bulkhead has
been installed for reducing barometric pressure varia-
tions and consequent noise from this source. A closed
loop dehumidification system has been installed to
maintain a low humidity within the adit. (Contractor's
abstract)

172

California Inst. of Tech. Seismological Lab., Pasadena.

SOURCE-MECHANISM FROM SPECTRA OF LONG
PERIOD SEISMIC SURFACE WAVES. 3. THE ALASKA
EARTHQUAKE OF JULY 10, 1958, by A. Ben-Menahem
and M. N. Toksöz. [1963] [14]p. (AFOSR-5359)
(AF AFOSR-63-25) AD 626488   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53:
905-919, Oct. 1963.

Source-mechanism is derived from amplitude and phase
spectra of mantle Love and Rayleigh waves of the Alaska
earthquake of July 10, 1958. An agreement between
theory and observations is obtained for a unilateral
fault of 300-350 km, which ruptured with a speed of
3-3.5 km/sec in the direction N40 degree W. Fault
length is in good agreement with the extent of aftershock
distribution in the month of July, 1958, and the time of
rupture checks with the duration of an impressive
T-phase recorded at Hawaii. The phases of the signals
are corrected for propagation, instrumental shift and
the source finiteness. Initial phases thus obtained

agree on a mechanism of a right double-couple with
a unit step-function in time. (Contractor's abstract)

173

California Inst. of Tech. Seismological Lab., Pasadena.

THE ANELASTICITY OF THE EARTH, by D. L.
Anderson and C. B. Archambeau. [1964] [14]p. incl.
diagrs. tables, refs. (AF AFOSR-63-25) AD 445223
Unclassified

Also published in Jour. Geophys. Research, v. 69:
2071-2084, May 15, 1964.

The attenuation of seismic waves is one manifestation
of the earth's anelasticity and is not unrelated to the
response of the earth to stresses of longer duration.
A method is developed for the analysis of the amplitudes
of dispersed wave trains and free oscillations which
yields the anelasticity (Q) as a function of depth in the
earth just as the frequency spectrum yields the elas-
ticity-density structure. The advantages and limitations
of the method are essentially identical to those of the
dispersion method. The amplitude decay vs period for
toroidal osciallations and Love waves was computed for
a variety of hypothetical Q distributions in the earth.
Those models which satisfy the available attenuation
measurements have a broad, highly attenuating zone in
the upper mantle and a high-Q lower mantle. (Con-
tractor's abstract, modified)

174

California Inst. of Tech. Seismological Lab., Pasadena.

A CATALOG OF SOUTHERN CALIFORNIA EARTH-
QUAKES AND ASSOCIATED ELECTRON DATA PROC-
ESSING PROGRAMS, by J. M. Nordquist. [1964]
[9]p. incl. diagrs. tables, refs. (AF AFOSR-63-25)
AD 437527   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
1003-1011, June 1964.

Epicenters, origin times, and other pertinent data on
approximately 9000 earthquakes in the Southern
California region, determined by the Seismological
Lab. at Pasadena for the period from Jan. 1, 1934 to
May 17, 1963, have been entered on IBM punched cards.
This card catalog may be used as input for programs
run on the IBM 7090, and has been converted to
punched tape for input to the Bendix G-15D in use at the
Laboratory. Programs now operational on the G-15D
will produce from the catalog lists of earthquakes which
satisfy given criteria of geographical location and/or
magnitude range. A system of G-15D programs for
calculating from the catalog the distribution of seis-
micity over the region is described. (Contractor's
abstract)

175

California Inst. of Tech. Seismological Lab., Pasadena.

EXCITATION OF SEISMIC SURFACE WAVES BY
ATMOSPHERIC NUCLEAR EXPLOSIONS, by M. N.
Toksöz and A. Ben-Menahem. [1964] [10]p. incl.
diagrs. tables, refs. (AF AFOSR-63-25) AD 445226
Unclassified

Also published in Jour. Geophys. Research, v. 69:
1638-1648, Apr. 15, 1964.

The Rayleigh waves generated by nuclear explosions
in the atmosphere and by earthquakes are investigated
to determine the relative effects of the source and the
propagation medium on the observed amplitude spec-
trums. It is found that when the waves from a given
source propagate along different paths the shapes of
the spectrums change markedly. Comparison of earth-
quake- and explosion-generated waves leads to the con-
clusion that the source characteristics are obscured by
the propagation effects. The theoretical expression for
the spectrum of the Rayleigh wave displacement is de-
rived for an explosion in a homogeneous atmosphere.
The yield of the explosion introduces a frequency-
dependent factor into the equations. Using this frequency
dependence, the relative yields of explosions are com-
puted from the amplitude-spectrum ratios of Rayleigh
waves recorded at a distant station. (Contractor's
abstract)

176

California Inst. of Tech. Seismological Lab., Pasadena.

A NOTE ON SURFACE WAVES FROM THE HARDHAT
NUCLEAR EXPLOSION, by K. Aki. [1964] [4]p. incl.
diagrs. (AF AFOSR-62-25)   Unclassified

Published in Jour. Geophys. Research, v. 69: 1131-
1134, Mar. 15, 1964.

The records from many LRSM stations have been
studied in order to determine the nature and origin of
the Love and Rayleigh waves that were generated by
the Hardhat explosion. A check was first made on the
validity of the assumption that Love and Rayleigh waves
originated from a common source at the same time.
The origin times of the two waves were shown to agree
within the experimental error, and the assumption was
not rejected. The amplitude ratio and the source phase
difference between the two waves were obtained for
various azimuths from the source, and they were shown
to be consistent with the double couple corresponding to
vertical strike-slip fault, the strike direction being
N30°W or N60°E. The observation, however, permits
a superposition of an explosive source, making the
contribution to the amplitude of Rayleigh waves less than
half of that from the double couple. (Contractor's
abstract)

177

California Inst. of Tech. Seismological Lab., Pasadena.

A PERTURBATION METHOD FOR ELASTIC WAVE
PROPAGATION. I. NONPARALLEL BOUNDARIES,
by I. Herrera. [1964] |7]p. incl. diagr. (AFOSR-65-
2901) (AF AFOSR-83-28) AD 450874   Unclassified

Also published in Jour. Geophys. Research, v. 69:
3845-3851, Sept. 1964.

This is the first of a series of papers in which a small-
perturbation theory for elastic wave propagation is
presented. Using classical perturbation techniques,
boundary conditions are obtained for the perturbation
of the displacement field which, by means of the integral
representation theorems of elastodynamics, permit us
to express the solutions to the problems as integrals of
known quantities. In this paper the method is formulated
for mediums with boundaries which are slightly non-
parallel. It is then applied to a study of the propagation
of Love waves through a crustal layer. (Contractor's
abstract)

178

[California Inst. of Tech. Seismological Lab., Pasadena]

BODY FORCE EQUIVALENTS FOR SEISMIC DISLOCA-
TIONS, by R. Burridge and L. Knopoff. [1984] [14]p.
incl. diagrs. refs. (AFOSR-65-2902) (AF AFOSR-63-
26) AD 813116   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
1875-1888, Dec. 1964.

An explicit expression is derived for the body force to
be applied in the absence of a dislocation, which pro-
duces radiation identical to that of the dislocation.
This equivalent force depends only upon the source and
the elastic properties of the medium in the immediate
vicinity of the source and not upon the proximity of
any reflecting surfaces. The theory is developed for
dislocations in an anisotropic inhomogeneous medium;
in the examples isotropy is assumed. For displace-
ment dislocation faults, the double couple is an exact
equivalent body force.   (Contractor's abstract)

179

[California Inst. of Tech. Seismological Lab., Pasadena]

ON A METHOD TO OBTAIN A GREEN'S FUNCTION
FOR A MULTI-LAYERED HALF SPACE, by I. Herrera.
[1964] [10]p. incl. diagr. refs. (AF AFOSR-83-26)
                        Unclassified

Published in Bull. Seismol. Soc. Amer., v. 54: 1087-
1095, Aug. 1984.

In this paper the surface wave terms of the Green's
function for a two-dimensional multi-layered half space
are obtained. The method used is new and remarkable
by its simplicity. It is based on the integral representa-
tion theorems for elastodynamics. The orthogonality

properties of surface waves are generalized to include
not only Love waves but Rayleigh waves as well.
(Contractor's abstract)

180

California Inst. of Tech. Seismological Lab., Pasadena.

TRANSMISSION OF LOVE WAVES PAST A CONTINEN-
TAL MARGIN, by L. Knopoff and J. A. Hudson. Oct.
1963, 17p. (AF AFOSR-83-26) AD 423484
                        Unclassified

A simplified two-dimensional model of the continental
margin is considered in which a single layer crust is
assumed to have an abrupt change in thickness. Love
waves are assumed to be propagating normally to this
discontinuity. By a Green's function technique, the
transmission coefficients are derived for waves propa-
gating in either direction. Numerical values are pro-
vided for a wide range of thicknesses and for one set
of physical parameters for crust and mantle. (Contrac-
tor's abstract)

181

California Inst. of Tech. W. M. Keck Lab. of
[Engineering Materials] Pasadena.

INFLUENCE OF PREFERRED ORIENTATION ON THE
HALL EFFECT IN TITANIUM, by L. Roesch and R. H.
Willens. [1962] [4]p. incl. diagrs. table. (AFOSR-
J1108) (AF 49(638)1034)   Unclassified

Also published in Jour. Appl. Phys., v. 34: 2159-
2163, Aug. 1963.

The effect of preferred orientation on the Hall effect
in titanium was examined in an attempt to resolve the
inconsistent results of previous investigators. Three
specimens of iodide titanium were prepared with differ-
ent textures and the Hall coefficient of each was meas-
ured between 4.2° and 295°K. The Hall coefficient was
found to depend on both temperature and preferred
orientation. At room temperature it was determined to
be $-1.8 \times 10^{-11} m^3/C$ in two specimens and $+2 \times$
$10^{-11} m^3/C$ in a third one. From the x-ray analysis of
the texture and the Hall coefficient data, it was con-
cluded that the positive component of the Hall coefficient
was associated with the hexagonal axis of titanium, being
parallel to the magnetic field. (Contractor's abstract,
in part)

182

California Inst. of Tech. W. M. Keck Lab. of
Engineering Materials, Pasadena.

[PHYSICAL PROPERTIES OF METALS AND ALLOYS
AT ELEVATED TEMPERATURES] by P. Duwez.
Final rept. Nov. 1, 1961-Apr. 30, 1964. Sept. 1964,
3p. (AFOSR-84-1879) (AF 49(638)1034)
                        Unclassified

Research is summarized on the effect of crystal orientation on electrical resistivity and Hall coefficient of hexagonal metals. Titanium and zirconium were chosen because previously reported data on Hall coefficient in polycrystalline titanium were contradictory. Results indicated that the Hall coefficient depends strongly on temperature and crystalline texture.

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California Inst. of Tech. [W. M. Keck Lab. of Engineering Materials] Pasadena.

MATERIALS PROBLEMS AT HIGH TEMPERATURES, by P. Duwez. [1964] [14]p. [AF 49(638)1034]
Unclassified

Published in High Temperatures in Aeronautics; Proc. Symposium held in Turin to celebrate the 50th anniversary of the Laboratorio di Aeronautica, Politecnico di Torino (Italy) (Sept. 10-12, 1962), ed. by C. Ferrari. Milano, Tamburini Editore, 1964, p. 385-398.

A review is presented of the materials problems encountered in high speed aircrafts and missiles. Both structural and engine materials are discussed. Each type of material (metallic, ceramic or plastic) has intrinsic temperature limitations and the term "high temperature" should be considered as a ratio of the operational temperature to the melting point of the material rather than the absolute value of the temperature in service. From this point of view, the high temperature problem exists for practically all engineering materials. The physical properties of interest at high temperature are discussed. Four classes of metallic materials, namely light metals, titanium alloys, steels and related alloys, and refractory metals are reviewed. For applications involving extremely high temperatures, cooling or ablation must be considered and this approach brings in physical properties of material which are less familiar to the aircraft or engine designers. Finally, a brief account is given of the most fruitful avenues for fundamental research in the field of high temperature materials.

164

California U. Center for Human Learning, Berkeley.

SECOND CALIFORNIA CONFERENCE ON VERBAL LEARNING AND VERBAL BEHAVIOR, by B. J. Underwood and L. J. Postman. [1963] [13]p. (AFOSR-66-1156) (AF AFOSR-63-229) AD 641437
Unclassified

Also published in Jour. Verbal Learning and Verbal Behavior, v. 2: 203-215, Aug. 1963.

The second of a series of 3 research conferences on verbal learning and verbal behavior was held from May 13-17, 1963, at the University of California Conference Center at Lake Arrowhead. The purpose of these conferences is to provide an opportunity for the exchange of information on current research developments in the areas of verbal learning and verbal behavior. The discussions were informal, with exclusive

emphasis on the ongoing research and current methodological and theoretical problems. A half-day session was allotted to each of the 10 participants, during which he was free to present any materials of his choosing.

185

California U. [Dept. of Astronomy] Berkeley.

THERMODYNAMICS OF A REACTING GAS, by M. S. Vardya. [1964] [6]p. (AFOSR-64-2307) (AF AFOSR-63-171) AD 452265
Unclassified

Also published in Amer. Jour. Phys., v. 32: 520-525, July 1964.

Thermodynamical properties of a gaseous mixture undergoing dissociation or ionization, or both, were considered in a general way. As a special case, the behavior of ionizing hydrogen gas was studied. It is found that a perfect gas behaves as an imperfect gas in many ways, when undergoing dissociation or ionization. (Contractor's abstract)

166

California U. Dept. of Astronomy, Berkeley.

THE SPECTRUM OF GAMMA PEGASI BETWEEN 3300 AND 3030A, by E. Bohm-Vitense, D. M. Pyper, and G. Wallerstein. Mar. 11, 1964, 3p. (AFOSR-65-0401) (AF AFOSR-63-171) AD 612576 Unclassified

Also published in Astrophys. Jour., v. 140: 607-609, Aug. 15, 1964.

A 2-A/mm spectrogram of γ Pegasi (type B2 IV) was obtained with the coude spectrograph of the 120 in. reflector. The plate is properly exposed from about 3300A to a little below 3050A. The primary purpose was to search for lines of Fe II to test the suggestion that the fluxes of B stars below λ 2500 might be strongly influenced by blanketing due to numerous lines of singly ionized atoms. The resonance lines of Be II were searched in order to set an upper limit to the abundance of beryllium.

167

California U. [Dept. of Astronomy] Berkeley.

A NEW METHOD OF AUTOMATIC COMPUTATION OF STELLAR EVOLUTION, by L. G. Henyey, J. E. Forbes, and N. L. Gould. [1964] [12]p. incl. diagrs. (AFOSR-66-0374) (AF AFOSR-63-171) AD 630234
Unclassified

Also published in Astrophys. Jour., v. 139: 306-312, Jan. 1, 1964.

A method is described for obtaining time sequences of stellar models describing evolutionary changes. This method is a modified version of an earlier one described by Henyey, Wilets, Bohm, LeLevier, and Levee (1959). The modifications involve the evaluation of all quantities

at the same discrete points. The technique provides for coupling the interior integrations to those for model atmospheres based on mixing-length theory. The scope of the formalism is such as to provide for a wide range of calculations for spherically symmetric configurations in hydrostatic equilibrium. (Contractor's abstract)

188

California U. Dept. of Chemistry, Berkeley.

PARTIAL RATE FACTORS FOR NITRATION OF FLUORANTHENE, by A. Streitwieser, Jr. and R. C. Fahey. [1962] [3]p. incl. diagr. tables, refs. (AFOSR-65-0215) (AF 49(638)105) AD 611348   Unclassified

Also published in Jour. Org. Chem., v. 27: 2352-2355, July 1962.

Nitration of fluoranthene gives the following partial rate factors relative to a 1-naphthalene position: (1) in acetic anhydride at $0°$ —1, 0.7; 3, 2.9; 7, 1.2; 8, 1.8; in acetic acid at $50°$ —1, 0.3; 3, 8.1; 7, 0.6; 8, 2.7.

189

California U. Dept. of Chemistry, Berkeley.

SPECTROSCOPIC AND THEORETICAL STUDIES OF MOLECULES WITH BONDING WHICH DEVIATES FROM NORMAL VALENCE RULES, by G. P. Pimental, B. Brocklehurst and others. Terminal rept. Mar. 1, 1961-Feb. 28, 1963. May 1963, 9p. (AFOSR-495f) (AF 49(638)944) AD 413870   Unclassified

Research was devoted to the elucidation of the structural properties and chemical bonding of molecules with bonding that deviates from normal valence rules. Effort was focused on 3 lines of attack: (1) Spectroscopic studies of the reactivity and molecular structure of free radicals and reactive molecules using the matrix isolation method, (2) Spectroscopic studies of stable molecules selected to develop and expand the applicability of the matrix isolation method, and (3) Development of new and novel spectroscopic techniques to facilitate future infrared studies of chemical species with extreme reactivity. (Contractor's abstract)

190

California U. Dept. of Chemistry, Berkeley.

INFRARED SPECTRA OF CARBON MONOXIDE IN AN ARGON MATRIX, by G. E. Leroi, G. E. Ewing, and G. C. Pimentel. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0518) (AF 49(638)944) AD 613862
Unclassified

Also published in Jour. Chem. Phys., v. 40: 2298-2303, Apr. 15, 1964.

The infrared absorption spectrum of carbon monoxide in an argon matrix shows prominent bands at 2148.8 and 2138.0 cm^{-1} with half-widths, respectively, 1.5 cm^{-1} and 3.5 $c.n^{-1}$. The relative intensities of these

bands are extremely dependent upon a variety of experimental conditions, including sample concentration, window temperature, and deposition rates. The variability shows that CO isolated in argon absorbs at 2148.8 cm^{-1} and that it does not rotate. The lower frequency absorption is due to aggregates. The frequency shift of the argon-isolated CO absorption relative to that of gaseous CO shows that carbon monoxide fits tightly in the argon lattice. In contrast, the CO aggregates absorb at lower frequency than gaseous carbon monoxide. Isotopic studies using $C^{13}O^{16}$ reveal vibrational coupling of 1.1 cm^{-1} between isotopically identical molecules in an aggregate. An increase in matrix cavity diameter would be needed if a stationary CO molecule begins to rotate in argon. This "site expansion," which could be as much as 0.4A, may be an important factor inhibiting rotation.

191

California U. Dept. of Chemistry, Berkeley.

OUT-OF-PLANE CH_2 BENDING POTENTIAL FUNCTIONS OF DIAZOMETHANE, KETENE, AND RELATED MOLECULES, by C. B. Moore and G. C. Pimentel. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0519) (AF 49(638)944) AD 613859   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1529-1534, Mar. 15, 1964.

The unusually low out-of-plane CH_2 bending potential constants of ketene and diazomethane are discussed in terms of a valence bond comparison of their electronic structures to those of ethylene and ammonia. The anharmonic energy levels of the CH_2 out-of-plane bending in diazomethane are fitted with an harmonic-quartic potential function. $V(\gamma) = (1/2 (2.74) \cdot \Delta \gamma^2 + 0.651 \cdot \Delta \gamma^4) \times 10^{-13}$ erg. A model is developed in which potential constants are transferred from the ethylene and ammonia molecules to the 2 valence-bond structures usually considered for the ketene and diazomethane molecules. The unusually high intensities of the bending overtones are found to be a necessary consequence of this treatment. A further experimental test may be found in the expected large change in dipole moment with vibrational state. The model provides a basis for understanding the potential functions of ketene and diazomethane, and for making qualitative predictions about other molecules such as cyanamide and CF_2N_2.

192

California U. Dept. of Chemistry, Berkeley.

HELIUM DIFLUORIDE: POSSIBLE PREPARATIVE TECHNIQUES BASED ON NUCLEAR TRANSMUTATIONS, by G. C. Pimentel, R. D. Spratley, and A. R. Miller. [1964] [1]p. (AFOSR-65-0520) (AF 49(638)944) AD 613853   Unclassified

Also published in Science, v. 143: 674, Feb. 14, 1964.

It might be possible to prepare difluoride by beta decay of tritium, lithium-6 transmutation, or alpha-particle bombardment. In the first method, which may be the

most feasible, tritrated potassium bifluoride could be used as a host lattice. The beta-decay recoil energy would not dislodge the daughter helium atom from the host site, thus helium difluoride could perhaps be formed in an ideally shaped lattice site.

193

California U. Dept. of Chemistry, Berkeley.

INFRARED SPECTRA OF GASEOUS DIAZOMETHANE, by C. B. Moore and G. C. Pimentel. [1964] [13]p. incl. diagrs. tables, refs. (AFOSR-65-0521) (AF 49-(638)944) AD 613852 Unclassified

Also published in Jour. Chem. Phys., v. 40: 329-341, Jan. 15, 1964.

The gaseous infrared spectra of CH_2N_2, $CHDN_2$, CD_2N_2, and $CH_2N^{15}N$ have been examined between 230 and 4000 cm^{-1} under medium resolution. Band positions have been measured for all the distinguishable parallel features. Nearly all of the perpendicular fundamentals have been resolved and analyzed. The $[A'' - 1/2(B'' + C'')]$-rotational constants derived are: $CH_2N^{15}N$, 8.747 ± 0.015 cm^{-1}; CD_2N_2, 4.253 ± 0.01 cm^{-1}; $CHDN_2$. 5.72 ± 0.1 cm^{-1}. These data combined with that given earlier for the CH_2N_2 isotope, show that the averaged distance of the hydrogen atoms from the molecular axis (in CH_2N_2 and in $CH_2N^{15}N$) is $0.9580 \pm 0.0006A$ and of the deuterium atoms (in CD_2N_2) is $0.9560 \pm 0.001A$. In contrast to earlier studies, no evidence was found for the presence of a tautomeric form of diazomethane in the samples studies.

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California U. Dept. of Chemistry, Berkeley.

SOLID INFRARED SPECTRA, ASSIGNMENT AND VIBRATIONAL POTENTIAL FUNCTION OF DIAZO-METHANE, by C. B. Moore and G. C. Pimentel. [1964] [14]p. incl. diagrs. tables, refs. (AFOSR-65-0522) (AF 49(638)944) AD 613854 Unclassified

Also published in Jour. Chem. Phys., v. 40: 342-355, Jan. 15, 1964.

Infrared spectra of pure solid diazomethane and diazomethane in nitrogen or argon are given here for the molecules CH_2N_2, CD_2N_2, $CHDN_2$, and $CH_2N^{15}N$. These data combined with the gas-phase spectra reported earlier provide a basis for a reassignment of the vibrational spectrum. The vibrational potential function, centrifugal distortion constants, Coriolis coupling constants, and thermodynamic functions of diazomethane have been calculated. The out-of-plane hydrogen bending force constant is found to be unusually low, 0.045×10^{-11} erg rad^{-2}. This is about 1/5 of that for ethylene and about 1/2 of that for ketene. The observed divergence of the energy levels of the out-of-plane hydrogen bending mode shows that there must be a larger positive quartic contribution to the potential function for this motion.

195

California U. [Dept. of Chemistry] Berkeley.

PREPARATION OF INERT GAS COMPOUNDS BY MATRIX ISOLATION: KRYPTON DIFLUORIDE, by J. J. Turner and G. C. Pimentel. [1963] [5]p. incl. diagrs. tables, refs. (AFOSR-65-0523) (AF 49(638)944) AD 614747 Unclassified

Also published in Hyman: Noble-Gas Compounds, Chicago U. Press, 1963, p. 101-105.

The matrix-isolation technique was used to prepare inert-gas compounds, e.g., XeF_2. The basic idea is to suspend the species in an inert solid matrix and investigate its spectroscopic properties. Inert gases and nitrogen are usual matrix materials. The spectroscopic properties of deposited mixtures of fluorine-argon, fluorine-xenon-argon, and fluorine-krypton-argon were studied; no evidence was found for an argon-fluorine compound by this method.

196

California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. XV. RELATIVE STA-BILITIES OF TRIPHENYLMETHYL AND BRIDGE-HEAD TRIPTYCYL CARBANIONS, by A. Streitwieser, Jr., R. A. Caldwell, and M. R. Granger. [1964] [1]p. (AFOSR-65-0225) (AF AFOSR-62-175) AD 611605 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 357t, 1964.

As part of a continuing study of base-catalyzed proton-exchange reactions between hydrocarbons and cyclo-hexylamine it was found that cesium cyclohexylamide is some 1000 to 10,000 times more reactive than lithium cyclohexylamide. Despite this large difference in reactivity, relative rates of exchange of different hydrocarbons are closely similar with both catalysts. The bridgehead position of triptycene is clearly comparable in acidity to aromatic hydrogens and its acidity is much greater than that of saturated hydrocarbons. This enhanced acidity of triptycene can only be attributed to the inductive effect of the attached benzene rings since resonance conjugation with these rings is unlikely. More than half of the enhanced acidity of triphenyl-methane over saturated hydrocarbons is due to the inductive effect of the 3 benzene rings and that less than half can be attributed to resonance stabilization of the carbanion. To the extent that relief of steric strain contributes to the acidity of triphenylmethane, the role of resonance is still less.

197

California U. Dept. of Chemistry, Berkeley.

SPECTRA OF SOME ALKALI SALTS OF HYDRO-CARBONS, by A. Streitwieser, Jr. and J. I. Brauman. [1963] [4]p. incl. diagrs. tables, refs. (AFOSR-65-0227) (AF AFOSR-62-175) AD 611606 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2633-2636, 1963.

Electronic absorption spectra are presented for lithium salts of fluorene, the benzofluorenes, 4,5-methylenephenanthrene, benzanthrene, fluoradene, 9-methyl- and 9-phenylfluorene, xanthrene, triphenylmethane, and tris-(p-biphenylyl)-methane in cyclohexylamine. Some cesium salts are included as well as some spectra in 1,2-dimethoxyethane and ether. The spectra are discussed in terms of simple molecular orbital theory and the cation effect and solvent effect are interpreted. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. IX. RATES OF EXCHANGE OF ARYL HYDROGENS WITH LITHIUM CYCLOHEXYLAMIDE IN CYCLOHEXYLAMINE, by A. Streitwieser, Jr. and R. G. Lawier. [1963] [2]p. incl. diagr. tables. (AFOSR-65-0228) (AF AFOSR-62-175) AD 611603   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2854-2855, Sept. 20, 1963.

By analogy with previous work with toluene, it was expected that aryl hydrogen exchange would proceed via the aryllithium intermediate. Confirming evidence was found in the relatively large decelerating effect of a phenyl substituent on the rate of exchange of the hydrogens of benzene. The greater exchange rate of the 3-diphenyiyl position over the 4-position indicates that carbene-carbanion resonance I is not important in these cases. The perturbation of the Pl-electron system due to a change in Coulomb integral by the presence of a negative charge on carbon would also appear to be of minor importance. The experimental results are interpretable quantitatively in terms of a simple electrostatic model.

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California U. Dept. of Chemistry, Berkeley.

TRITICVEPROTONATION OF BIPHENYLENE, by A. Streitwieser, Jr. and I. Schwager. [1963] [1]p. incl. diagr. (AFOSR-65-0229) (AF AFOSR-62-175) AD 611601   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2855, 1963.

The rates of tritiodeprotonation of biphenylene were determined for both the 1- and 2-positions. The rate constants obtained were $k-\alpha = 0.0000432$/sec and $k-\beta = 0.00275$/sec; $k-\beta/k-\alpha = 64$.

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California U. Dept. of Chemistry, Berkeley.

ON HUHN'S OMEGA DOUBLE PRIME-MOLECULAR

ORBITAL METHOD, by A. Streitwieser, Jr., A. Heller, and M. Feldman. [1964] [3]p. incl. tables. (AFOSR-65-0377) (AF AFOSR-62-175) AD 611731
                     Unclassified

Also published in Jour. Phys. Chem., v. 68: 1224-1226, 1964.

Further study was made of the method of Kuhn (Tetrahedron, v. 19 (Suppl. 2), 88, 389, 437, 1963) which gives consideration to potential associated with neighboring atoms. The omega single prime technique, with effect limited to the nearest neighbors of the carbon atom, was applied to the benzyl cation, azulene, fulvene, and heptafulvene. The omega single prime was regarded as showing promise.

201

California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. XI. ACTIVATION PARAMETERS FOR EXCHANGE OF TOLUENE-α-d WITH LITHIUM CYCLOHEXYLAMIDE IN CYCLOHEXYL-AMINE, by A. Streitwieser, Jr., R. A. Caldwell and others. [1964] [3]p. incl. diagr. table. (AFOSR-65-0455) (AF AFOSR-62-175) AD 613778 Unclassified

Also published in Jour. Phys. Chem., v. 68: 2916-2918, Oct. 1964.

The dependence at 2 temperatures of the pseudo-first-order rate constants for exchange of toluene-α-d with cyclohexylamine on the concentration of the lithium cyclohexylamide catalyst leads to the thermodynamic parameters for the aggregation equilibrium of lithium cyclohexylamide and the activation parameters for the bimolecular exchange reaction. The equilibrium is unusual in that aggregation is accompanied by an increase in entropy; the exchange reaction itself has an unusually negative entropy of activation. These results are interpreted in terms of specific solvation effects. (Contractor's abstract)

202

California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. XII. AGGREGATION OF LITHIUM CYCLOHEXYLAMIDE IN CYCLOHEXYLA-MINE BY ISOPIESTIC MEASUREMENT, by A. Streitwieser, Jr. and W. M. Padgett. [1964] [4]p. incl. diagrs. table. (AFOSR-65-0456) (AF AFOSR-62-175) AD 613779   Unclassified

Also published in Jour. Phys. Chem., v. 68: 2919-2922, Oct. 1964.

Isopiestic molecular weight measurements of lithium cyclohexylamide in cyclohexylamine show a degree of aggregation in semiquantitative agreement with theories derived previously from kinetic measurements. A modified technique for such isopiestic measurements is described. (Contractor's abstract)

203

California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. XIII. SOME CONDUC-
TIVITY STUDIES OF LITHIUM CYCLOHEXYLAMIDE,
FLUORENYLLITHIUM, AND LITHIUM PERCHLORATE
IN CYCLOHEXYLAMINE, by A. Streitwieser, Jr.,
W. M. Padgett, and I. Schwager. [1964] [4]p. incl.
diagrs. table, refs. (AFOSR-65-0457) (AF AFOSR-
62-175) AD 613845   Unclassified

Also published in Jour. Phys. Chem., v. 68: 2922-2925,
Oct. 1964.

An apparatus is described for determining conductivities
in an inert atmosphere. Measurements with lithium
perchlorate, lithium fluorenyl, and lithium cyclohexyla-
mide in cyclohexylamine at 49.5° give ion-pair dissoci-
ation constants in the range 10^{-10} to 10^{-12} mol/1.
These results indicate that the bonds to lithium in each
of these salts are about equally ionic; the results con-
firm the conclusions reached in previous studies of
kinetics of exchange with lithium cyclohexylamide in
cyclohexylamine that free ions are not significantly in-
volved in the concentration region used. (Contractor's
abstract)

204

California U. [Dept. of Mathematics] Berkeley.

ALGEBRAIC RINGS, by M. J. Greenberg. [1964]
[10]p. incl. refs. (AFOSR-65-0865) (AF AFOSR-65-
57) AD 617476   Unclassified

Also published in Trans. Amer. Math. Soc., v. 111:
472-481, June 1964.

An algebraic ring is roughly speaking an associative
algebra which is an algebraic variety. Proof is pre-
sented that (1) an algebraic ring is Artinian; (2) an
algebraic ring is, under its addition, a unipotent
algebraic group; and (3) the unit group of an algebraic
ring is a Zariski open subset. Furthermore, some
structure theorems for algebraic rings are proved: a
commutative local ring variety of positive characteristic
is a finite algebra over a ring of Witt vectors, and a
simple ring variety is a matric ring (over an algebrai-
cally closed field. (Math. Rev. abstract)

205

California U. [Dept. of Mathematics] Berkeley.

THE STEENROD SQUARES IN THE MOD TWO
COHOMOLOGY ALGEBRA OF AN H-SPACE, by E.
Thomas. [1964] [5]p. (AFOSR-66-2357) (AF AFOSR-
63-336) AD 642813   Unclassified

Also published in Jour. Colloq. Topol., Sept. 1964,
p. 113-117.

Let X be an H-space, X is assumed to be finite dimen-
sional in the sense of integral homology. The work of
Hopf then describes the rational cohomology algebra of

X as: $H^*(X;Q) = \Lambda(X_1, ''', x_n)$, deg X is odd. Borel con-
sidered the analogous question for cohomology with mod
p coefficients, p a prime, a showed that: $H^*(Xi Z_p) =$
$\Lambda(Xi ''', x_n) [x Z_p y_1, '''y_m]/(\gamma_1{}^{pr}1, ''', y_m{}^{prm})$. Here,
for p odd, de Xi is odd and deg yi even. In the case of
mod p cohomology the following question is left open by
the structure theory developed above. Question: what
is the structure of $H^*(X, Zp)$ as an A(p) algebra? Here
A(p) denotes the mod p Steenrod algebra and X an H-
space. The work described in this note gives some
answer to this question for the case p = 2. Let $H^*(x)$
denote the mod 2 cohomology algebra of X. A central
theorem along these lines states that: If X is an H-space
such that $H^*(x)$ has a primitive set of generators, V is a
primitive class of odd degree and t an integer such that
(deg v-t) = 1 mod 2, then there exists a primitive class
u $H^*(x)$ such that m_v-Sgt(u). Moreover, Sgt (v) = 0.

206

California U. Dept. of Physics, Berkeley.

[TIME VARIATIONS OF COSMIC RADIATION AT HIGH
ALTITUDES IN THE POLAR REGIONS] by R. R.
Brown. Final rept. July 1, 1960-Sept. 30, 1962.
Nov. 1962, 6p. (AFOSR-419) (AF 49(638)873)
AD 291157   Unclassified

This report gives the final summary of the activities
undertaken towards exploring radiation effects at balloon
altitudes in the auroral zone. This location offers the
best opportunity for obtaining information on particle
bombardment of the atmosphere resulting from solar
activity. Thus, solar proton events as well as electron
events associated with the aurora and magnetic dis-
turbances are often found in this region. Experimental
programs will be carried out to study the relationship
of visible aurora with x-rays in the auroral zone, the
latitude extent of electron precipitation during the mag-
netic and ionospheric disturbances, and the morphology
and fluctuations in time of electron precipitation on
conjugate regions of the auroral zone.

207

California U. Dept. of Physics, Berkeley.

OBSERVATIONS RELATING TO THE DISTANCE SCALE
FOR MOTIONS OF ELECTROJET-ELECTRON PRE-
CIPITATION REGIONS IN THE AURORAL ZONE, by
D. P. Marsh. [1963] [8]p. (AFOSR-64-0653)
(AF 49(638)873) AD 434848   Unclassified

Also published in Jour. Geophys. Research, v. 68:
4167-4174, July 15, 1963.

From a comparison of x-ray, ionospheric absorption,
and geomagnetic observations during an intense electron
precipitation event in the auroral zone, it is shown that
the distance scale for motions of electrojet-electron
precipitation regions is smaller than previously con-
sidered. This requires a downward revision of the
correction factors for currents induced in the earth by
ionospheric current systems. (Contractor's abstract)

208

California U. [Dept. of Physics] Berkeley.

SOME NEW ASPECTS OF CYLCOTRON RESONANCE
IN COPPER, by J. F. Koch, R. A. Stradling, and
A. F. Kip. June 12, 1963, 40p. (AFOSR-64-0769)
(AF AFOSR-62-127) AD 430971   Unclassified

Also published in Phys. Rev., v. 133: A240-A252,
Jan. 6, 1964.

The development of improved techniques has made
possible a new series of cyclotron resonance experi-
ments on Cu which gives more accurate and extended
information on electron cyclotron masses. New orbits
which have been observed and measured include: (1) a
limiting point orbit, (2) orbits extending through 3 and
4 Brillouin zones, (3) orbits whose centers are neither
at the center nor edge of the zone, and (4) orbits ob-
served with the magnetic field tipped at large angles
(up to 80°) with respect to the crystal surface. The
neck orbit has been observed and measured with the
field along the 111 direction. The cyclotron mass ratio
for this orbit is 0.46. Certain discrepancies and puzzl-
ing aspects of earlier data have been clarified and the
present data are in excellent accord with de Haas-van
Alphen and magnetoacoustic data on the geometry of the
Fermi surface. (Contractor's abstract)

209

California U. [Dept. of Physics] Berkeley.

THE DYNAMICS OF SPHERICAL STELLAR SYSTEMS.
II. THEORETICAL MODELS, by R. W. Michie and P.
H. Bodenheimer. Mar. 25, 1963, 13p. (AFOSR-64-
1042) (AF AFOSR-62-199) AD 441491 Unclassified

Also published in Monthly Notices, Roy. Astron. Soc.,
v. 126: 269-281, 1963.

This article presents an extensive set of models for
spherical stellar systems using a distribution function
which for the inner regions is obtained from the
Boltzmann equation with encounters. It is assumed
that in the early stages of the formation of clusters and
elliptical galaxies, encounters and orbital mixing
played an important role in determining the presently
observed structure. Since this early time period the
systems have not changed much, and can now be con-
sidered to be in or near dynamical equilibrium. These
assumptions permit an extension of the initial distribu-
tion function to describe the whole system at later times.
Numerical integrations have produced models with a
wide variety of structure, which are in agreement with
the simple sensity distributions of star clusters as well
as the more complicated run of the density observed in
some spherical galaxies. (Contractor's abstract)

210

California U. [Dept. of Physics] Berkeley.

THE DYNAMICS OF SPHERICAL STELLAR SYSTEMS
III. THE RELATIVE LOSS OF STARS WITH DIFFER-

ENT MASS, by R. W. Michie. Mar. 25, 1963, 11p.
(AFOSR-64-1043) (AF AFOSR-62-199) AD 441471
                                              Unclassified

Also published in Monthly Notices, Roy. Astron. Soc.,
v. 126: 331-341, 1963.

A distribution function which includes a velocity-space
anisotropy and which satisfies the Boltzmann equation
for both large and small energy is used to calculate
the relative rate of stellar mass loss from spherical
systems. The calculations are based on the velocity-
space flux vector, and do not employ the use of a re-
laxation time. The loss of stars of different mass
at varying distances throughout the system from differ-
ent spherical models demonstrates the dynamical im-
portance of the low mass stars. The stars whose mass
is about the average stellar mass may leave the system,
as a result of distant encounters, from 10 to over 100
times faster than the average stars, depending on the
model. The depletion of low luminosity stars in galactic
clusters and the distribution of white dwarfs in globular
clusters is briefly discussed. (Contractor's abstract)

211

California U. [Dept. of Physics] Berkeley.

THE DYNAMICS OF SPHERICAL STELLAR SYSTEMS.
IV. A STUDY OF GALACTIC CLUSTERS, by R. W.
Michie. Jan. 29, 1963, 19p. (AFOSR-64-1044)
(AF AFOSR-62-199) AD 441497   Unclassified

Also published in Roy. Astron. Soc., v. 126: 499-
517, 1963.

A comparison is made between the galactic cluster
surface densities resulting from star counts to faint
magnitudes with theoretical surface densities. The
latter are calculated using a distribution function ob-
tained from the Boltzmann equation with encounters and
with a spatial truncation to approximate the effects of
the tidal force exerted by the Galaxy. On the basis of
limited data there is a relation between the degree of
depletion of very faint stars and the model parameter
C in the sense that in systems for which C is large, the
depletion of faint stars is not very great, for a very
small C, there can be a very rapid decrease in the
luminosity function at faint magnitudes. Young galactic
clusters are particularly important, for the elongated
orbits must be a result of initial conditions, in particu-
lar the degree of metal abundance, state of turbulence
and large scale motion of the initial gas cloud. (Con-
tractor's abstract)

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California U. [Dept. of Physics] Berkeley.

[HIGHER CONVECTIVE VERTICAL MODES AN.
INSTABILITY RATES IN THE SOLAR HYDROGEN
CONVECTION ZONE] Strömungsformen verschiedener
vertikaler Wellenlangen in der solaren Wassertoff-
konvektionszone, by K. H. Böhm. [1963] [13]p. incl.
diagrs. refs. (AFOSR-66-0370) (AF AFOSR-62-199)
AD 640221   Unclassified

Also published in Zeitschr. Astrophys., v. 57: 265-277, 1963.

Higher convective modes and their rates of instability have been computed for the model of the solar hydrogen convection zone given by E. Bohm-Vitense (1958). The calculations are based on the linearized hydrodynamic equations. Viscosity and radiative conductivity have been neglected. The present computations cover the fundamental, the 1, 2, 3, and 4 mode in the horizontal wavelength range $5000 \text{ km} \geq \lambda/2 \geq 170 \text{ km}$. A method of matrix iteration has been used for the numerical determination of the higher eigenvalues and eigensolutions of the finite difference-approximations of the hydrodynamic equations. (Contractor's abstract)

213

California U. Dept. of Physics, Berkeley.

COLLISION-INDUCED RELAXATION OF ORIENTED Rb^{87} ATOMS IN THE $5^2P_{1/2}$ STATE (Abstract), by J. Yellin and R. Marrus. [1964] [1]p. (AFOSR-66-1562) (AF AFOSR-62-346) AD 640222 Unclassified

Presented at meeting of the Amer. Phys. Soc., Dec. 21-23, 1964.

Also published in Bull. Amer. Phys. Soc., Series II, v. 9: 720, 1964.

Mixing of alkali excited states by collisions with a buffer gas has a pronounced effect on the structure of the optical-pumping transients. Cross sections for disorienting a Rb^{87} atom in the $5^2P_{1/2}$ state by collisions with helium, neon, and argon have been determined from a study of optical-pumping transients. The cross sections are $1.2(0.6) \times 10^{-17}$, $5.0(2.5) \times 10^{-17}$, and $3.5(1.7) \times 10^{-16}$ cm^2 for helium, neon and argon respectively. The model used to obtain the cross sections and the errors involved is discussed.

214

California U. Dept. of Physics, Berkeley.

STUDY OF OPTICAL-PUMPING TRANSIENTS IN RUBIDIUM AND CESIUM VAPORS (Abstract), by J. Yellin, R. Marrus, and W. A. Nierenberg. [1964] [1]p. (AFOSR-66-1564) (AF AFOSR-62-346) AD 640253 Unclassified

Presented at meeting of the Amer. Phys. Soc., Denver, Colo., June 25-27, 1964.

The shape of optical-pumping transients in rubidium vapor were studied in detail. Observed transients can be separated into a sum of exponential components. These components are found to be in agreement with a theoretical model based on complete mixing in the excited state. From a study of the times of the individual components as a function of light intensity, relaxation times can be deduced. By using this method, the relaxation time of cesium vapor in a 200-ml Pyrex bulb with no buffer gas was measured to be $T_1 = 0.6(1)$ msec.

This corresponds to an average of 2.5 all collisions before relaxation.

215

California U. Dept. of Physics, Berkeley.

ELECTRONIC g-FACTOR, HYPERFINE-STRUCTURE SEPARATION, AND MAGNETIC MOMENT OF Cu^{64} (Abstract), by B. M. Dodsworth and H. A. Snugart. [1964] [1]p. (AFOSR-66-1565) (AF AFOSR-62-346) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

An atomic-beam "flop-in" apparatus has been used to investigate the properties of radioactive Cu^{64} (12.8 h). Both the $\Delta F = 0$ and $\Delta F = \pm 1$ resonances were observed at several values of magnetic field. A least-squares-fit analysis of all resonances leads to the following results: $\Delta\nu (3/2 - 1/2) = -1282.140(10)$ mc/sec, μ_1 (uncorrected) $= -0.216(2)$, and $g_J = -2.00229(2)$, where $g_J = \mu_J/J$ (in units of μ_0). The magnetic moment is calculated from the Fermi-Segrè formula, and its error is taken to be 1% to include a possible hyperfine-structure-anomaly effect. The hyperfine-structure separation and g_J value represent improvements of previous measurements.

216

California U. Dept. of Physics, Berkeley.

DAY-NIGHT RATIO FOR AURORAL ABSORPTION EVENTS ASSOCIATED WITH NEGATIVE MAGNETIC BAYS, by R. R. Brown and J. R. Barcus. [1963] 6p. incl. diagrs. tables, refs. (AFOSR-J1255) (AF AFOSR-62-422) AD 424323

Also published in Jour. Geophys. Research, v. 68: 4175-4180, July 15, 1963.

An examination of solar illumination effects for auroral absorption events centered over the 27.64 mc riometer antenna pattern at College, Alaska, shows that the day-night absorption ratio is essentially unity. This finding indicates that electron-positive ion recombination far outweighs electron attachment processes in auroral absorption regions and is consistent with present knowledge of the electron bombardment as well as ionic-molecular processes at the 90 to 100 km level. Further implications of this result are discussed. (Contractor's abstract)

217

California U. Dept. of Physics, Berkeley.

BALLOON OBSERVATIONS OF THE EXTENT AND STRUCTURE OF AURORAL-ZONE ELECTRON PRECIPITATION EVENTS, by R. R. Brown and J. R. Barcus. [1963] 9p. incl. diagrs. refs. (AFOSR-64-0372) (AF AFOSR-62-422) AD 434532 Unclassified

Also published in Jour. Geophys. Research, v. 68: 6069-6077, Nov. 15, 1963.

Simultaneous balloon observations of auroral-zone electron precipitation from College and Fort Yukon, Alaska, in June of 1962 showed examples of the electron influx increasing with increasing geomagnetic latitudes, both with and without magnetic bay disturbances. Under more disturbed conditions, the x-ray flux recorded by the southern balloon far exceeded that by the northern balloon, indicating a sharp boundary for the electron precipitation region as suggested by O'Brien on the basis of satellite measurements. (Contractor's abstract)

218

California U. Dept. of Physics, Berkeley.

A STUDY OF THE RELATIONSHIP BETWEEN AB-
SORPTION-TIME PROFILES OF POLAR-CAP-
ABSORPTION EVENTS AND FORBUSH DECREASES
OF COSMIC-RAY INTENSITY, by J. E. Goaling.
[1964] [6]p. incl. diagrs. tables. (AFOSR-65-1751)
(AF AFOSR-62-422) AD 625679   Unclassified

Also published in Jour. Geophys. Research, v. 69: 1233-1238, Apr. 1, 1964.

Forbush decrease data recorded by neutron monitors during PCA events support the interpretation of the absorption-time profiles of PCA events as due to solar particles under the influence of magnetic fields carried by solar plasma. All PCA events showing evidence of strong trapping of solar particles are accompanied by strong Forbush decreases, the magnitudes of which are a function of the delay time from flare to SC storm. Those PCA events showing little evidence of trapping are accompanied by only very weak decreases. The large western excess of these latter events is explained in terms of sun-earth magnetic linkage set up by earlier flare activity. The relative merits of 2 models of the interplanetary fields are examined. (Contractor's abstract)

219

California U. Dept. of Physics, Berkeley.

ON THE CONTRIBUTION OF SOLAR-FLARE ALPHA PARTICLES TO POLAR CAP ABSORPTION EVENTS, by R. A. Weir and R. R. Brown. [1964] [6]p. incl. diagrs. (AFOSR-65-1752) (AF AFOSR-62-422) AD 626491   Unclassified

Also published in Jour. Geophys. Research, v. 69: 2193-2198, June 1, 1964.

A series of calculations are carried out to determine the relative importance of ionization from solar-flare α-particles to polar cap absorption events. The exponential rigidity spectrums for solar-flare radiation discussed by Freier and Webber are used. To illustrate the actual magnitudes involved, typical fluxes, rigidity spectrums, and proton α-particle ratios from major polar cap events are used. The electron production

rates, electron densities, and specific absorption as a function of altitude for a proton α-particle ratio of unity are presented for a location with cutoff rigidity P_c = 470 mev. These results indicate that α-particles contribute significantly, producing as much as 75% of the ionospheric absorption when the proton α-particle ratio is unity. (Contractor's abstract)

220

California U. [Dept. of Physics] Berkeley.

A COMPARISON OF AURORAL LUMINOSITY AND IONOSPHERIC ABSORPTION USING WIDE-ANGLE MEASUREMENTS, by R. R. Brown and J. R. Barcus. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-65-1759) (AF AFOSR-62-422) AD 626492
                    Unclassified

Also published in Arkiv Geofysik, v. 4: 395-403, 1964.

A comparison of auroral luminosity variations over the antenna pattern of the 27.6 mc/s riometer at College, Alaska, with ionospheric absorption records indicates, as noted earlier by other means, that ionospheric absorption is associated principally with the post-breakup aurora suggests that the fluctuations in the relation between auroral absorption and geomagnetic disturbance, as well as auroral luminosity and ionospheric absorption, are due to differences in the electron energy spectrum from event to event rather than spatial structure of the particle bombardment. (Contractor's abstract)

221

California U. [Dept. of Physics] Berkeley.

OBSERVATIONS ON THE RELATIONSHIP OF ENERGETIC PARTICLE PRECIPITATION TO AURORAL ZONE PHENOMENA, by J. R. Barcus. June 1964, 40p. (AF AFOSR-62-422) AD 602434   Unclassified

A series of instrumented balloon flights was made from Barrow, Alaska, to study the relationship of electron precipitation to auroral zone phenomena. Observations and results are presented on the relationship of energetic electrons to visual aurora, auroral absorption, and to geomagnetic pulsations.

222

California U. Dept. of Physics, Berkeley.

BOOTSTRAPS AND THE PION-NUCLEON SYSTEM, by E. Abers and C. Zemach. [1963] [14]p. incl. diagrs. tables, refs. (AFOSR-64-0263) (AF AFOSR-63-130) AD 432529   Unclassified

Also published in Phys. Rev., v. 131: 2305-2318, Sept. 1, 1963.

It has been suggested that all the observable properties of strongly interacting systems can be determined self-consistently if there do not exist any elementary particles in the conventional sense. This conjecture is applied to

the nucleon mass and the pion-nucleon coupling constant, which are calculated under the assumption that the nucleon is composite, and that its existence is a consequence of the same forces which produce pion-nucleon resonances. It is shown qualitatively that the self-consistent method not only predicts the nucleon and the P 3/? 3/2 resonance, but excludes other combinations which are not observed. This notion is illustrated by consideration of hypothetical interactions between nucleons and scalar mesons and between λ and ʋ hyperons of negative relative parity. (Contractor's abstract)

223

California U. [Dept. of Physics] Berkeley.

SINGULARITIES IN THE UNPHYSICAL SHEETS AND THE ISOBAR MODEL, by R. C. Hwa. [1963] [13]p. incl. diagrs. refs. (AFOSR-64-0264; (AF AFOSR-63-130) AD 432530   Unclassified

Also published in Phys. Rev., v. 130: 2580-2592, June 15, 1963.

Scattering amplitudes involving 2- and 3-particle states continued across the inelastic section of the unitarity cut, and the singularities in the unphysical sheets thus reached are determined. Associated with an unstable particle is a complex unitarity cut, through which we further continue into another unphysical sheet. Dynamical singularities associated with a Born-type diagram for the 3-particle scattering amplitude are found to be present in the elastic scattering and the production amplitudes also because of the coupling by unitarity. These singularities are isolated from the physical region by the complex unitarity cut and thus cannot be directly responsible for any resonance phenomenon. (Contractor's abstract, modified)

224

California U. Dept. of Physics, Berkeley.

A GENERALIZED SUSCEPTIBILITY AND HARTREE-FOCK APPROACH TO THE MANY-BODY PROBLEM, by V. J. Emery. [1964] [16]p. incl. refs. (AFOSR-64-2469) (AF AFOSR-63-130) AD 453750
                                   Unclassified

Also published in Nuclear Phys., v. 57: 303-318, 1964.

It is shown that the 2-particle density matrix and hence the grand partition function for a many-body system may be obtained from generalized susceptibilities which specify the linear response of the system to external perturbations which excite oscillations in the relative motion of pairs of particles. The susceptibilities are calculated in a generalized time-dependent Hartree-Fock approximation which is a generalization of the BCS theory of superconductivity or the Bogolyubov, Brueckner-Sawada theory of a Bose system. The partition function obtained in this manner is equivalent to a sum of ladder graphs for a normal Fermion system and to a sum of quasi-particle ladder graphs for a "superconductive" Fermion system, unphysical poles

in the reaction matrix do not arise. The method is extended to give a finite temperature version of Brueckner's theory. Equivalent results are derived for systems of bosons. (Contractor's abstract)

225

California U. Dept. of Physics, Berkeley.

FINE STRUCTURE OF HELIUM, by C. Schwartz. [1964] [7]p. incl. diagr. tables, refs. (AFOSR-65-1110) (AF AFOSR-63-130) AD 620478   Unclassified

Also published in Phys. Rev., v. 134: A1181-A1187, June 1, 1964.

Under the expectation that experiments will soon give values for the fine structure intervals of the 2^3P state of helium to accuracy of $1/10^6$, a program of calculations is undertaken which will probably lead to a new determination of the fine-structure constant α. This paper gives a brief survey of the over-all program, and a detailed report of the successful completion of the first task: the construction of approximate solutions to the Schrödinger equation which lead to average values of the leading fine structure operators accurate to about one part per million. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

SCATTERING OF SOUND BY A CLASSICAL VORTEX, by A. L. Fetter. [1964] [6]p. incl. refs. (AFOSR-65-1111) (AF AFOSR-63-130) AD 620479   Unclassified

Also published in Phys. Rev., v. 136: A1488-A1493, Dec. 14, 1964.

The cross section for the scattering of sound by a vortex is calculated using the linearized equations of classical hydrodynamics. With a circulation κ, the differential cross section in the long-wavelength limit is $1/2 \pi (\kappa/2\pi c)^2 \kappa \sin^2 c (1-\cos c)^{-2}$, where c is the speed of sound. Possible experimental verification is suggested, with particular reference to liquid He II. (Contractor's abstract)

227

California U. [Dept. of Physics] Berkeley.

PHOTONS AND GRAVITONS IN S-MATRIX THEORY: DERIVATION OF CHARGE CONSERVATION AND EQUALITY OF GRAVITATIONAL AND INERTIAL MASS, by S. Weinberg. [1964] [8]p. (AFOSR-64-2044) (AF AFOSR-63-232) AD 452516   Unclassified

Also published in Phys. Rev., v. 135: B1049-B1056, Aug. 24, 1964.

A purely S-matrix-theoretic proof is given of the conservation of charge (defined by the strength of soft photon interactions) and the equality of gravitational and inertial mass. (Contractor's abstract)

228

California U. [Dept. of Physics] Berkeley.

FUNCTIONAL ANALYSIS AND SCATTERING THEORY, by M. Scadron, S. Weinberg, and J. Wright. [1964] [6]p. (AFOSR-64-2045) (AF AFOSR-63-232) AD 452330   Unclassified

Also published in Phys. Rev., v. 135: B202-B207, July 13, 1964.

This paper is concerned with the application of functional analysis to the problem of scattering of a single nonrelativistic particle by a fixed interaction V. (Contractor's abstract)

229

California U. [Dept. of Physics] Berkeley.

PERTURBATION THEORY FOR STRONG REPULSIVE POTENTIALS, by S. Weinberg. [1963] [5]p. (AFOSR-64-2437) (AF AFOSR-63-232) AD 453746
Unclassified

Also published in Jour. Math. Phys., v. 5: 743-747, June 1964.

A conformal mapping of the coupling-constant plane is used to rearrange the Born series. The new series is guaranteed to converge for any decent repulsive potential. The first few terms do well in actual calculations of the scattering length. (Contractor's abstract)

230

California U. [Dept. of Physics] Berkeley.

POTENTIAL THEORY CALCULATIONS BY THE QUASIPARTICLE METHOD, by M. Scadron and S. Weinberg. [1963] [8]p. (AFOSR-64-2438) (AF AFOSR-63-232) AD 453748   Unclassified

Also published in Phys. Rev., v. 133: B1589-B1596, Mar. 23, 1964.

The quasiparticle method is used to find binding energies, scattering lengths, and cross sections for one particle in a strong Yukawa, Hulthen, or exponential potential. The results are excellent in the lowest approximation. (Contractor's abstract)

231

California U. [Dept. of Physics] Berkeley.

FEYNMAN RULES FOR ANY SPIN, by S. Weinberg. [1964] [15]p. (AFOSR-64-2439) (AF AFOSR-63-232) AD 453803   Unclassified

Also published in Phys. Rev., v. 133: B1318-B1332, Mar. 9, 1964.

The explicit Feynman rules are given for massive

particles of any spin j, in both a 2j + 1-component and a 2(2j + 1)-component formalism. The propagators involve matrices which transform like symmetric traceless tensors of rank 2j; they are the natural generalizations of the 2 x 2 four-vector σ-μ and 4 x 4 four-vector γ-μ for j = 1/2. The calculation uses field theory, but only as a convenient instrument for the construction of a Lorentz-invariant S matrix. This approach is also used to prove the spin-statistics theorem, crossing symmetry, and to discuss T, C, and P. (Contractor's abstract)

232

California U. [Dept. of Physics] Berkeley.

FEYNMAN RULES FOR ANY SPIN. II. MASSLESS PARTICLES, by S. Weinberg. [1964] [15]p. (AFOSR-64-2440) (AF AFOSR-63-232) AD 453804
Unclassified

Also published in Phys. Rev., v. 134: B882-B896, May 25, 1964.

The Feynman rules are derived for massless particles of arbitrary spin j. Some other subjects discussed include: T, C, and P for massless particles and fields; the extent to which chirality conservation implies zero physical mass; and the Feynman rules for massive particles in the helicity formalism. The approach is based on the assumption that the S matrix is Lorentz invariant, and makes no use of Lagrangians or the canonical formalism. (Contractor's abstract)

233

California U. [Dept. of Physics] Berkeley.

METHODS FOR DETERMINING THE SPIN AND PARITY OF THE β PARTICLE, by C. Zemach. [1964] [8]p. (AFOSR-64-2441) (AF AFOSR-63-232) AD 453802   Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 1605-1612, June 16, 1964.

Experimental tests for the spin and parity of the β particle are derived from angular correlations of particles associated with production and decay of the β. (Contractor's abstract)

234

California U. [Dept. of Physics] Berkeley.

THREE-PION DECAYS OF UNSTABLE PARTICLES, by C. Zemach. [1963] [20]p. (AFOSR-64-2442) (AF AFOSR-63-232) AD 453755   Unclassified

Also published in Phys. Rev., v. 133: B1201-B1220, Mar. 9, 1964.

The properties of particles of arbitrary spin and parity that decay into 3 pseudoscalar mesons are surveyed, with primary attention to 3 π decays, in order

to ftnd efficient means of detecting such particles. Among the topics considered are: the general forms of amplitudes subject to tnvariance and symmetry requtrements; the regions of vanishing density in ihe Dalitz ploi; branching ratios; angular correlaitons among vectors normal io and lying in the production and decay planes; and spectal decay modes through 2-particle resonances. The angular correlations are discussed tn detail for processes tndependent of the intrinsic spin of the production particles, as is appropriate 'n coherent nuclear processes, and a framework of analysis is provided for more complex problems. (Contractor's abstraci, modified)

235

California U. [Dept. of Physics] Berkeley.

SYSTEMATIC SOLUTION OF MULTIPARTICLE SCATTERING PROBLEMS, by S. Weinberg. [1963] [25]p. (AFOSR-64-2443) (AF AFOSR-63-232) AD 453744   Unclassified

Also published in Phys. Rev., v. 133: B232-B256, Jan. 13, 1964.

Scattering problems for 3 or more particles cannot be solved by a direci use of those techniques, like the Fredholm or quasiparticle methods, which work for 2 particles. It is shown how to overcome any difficulty, and calculaie all Green's functions and scattering amplitudes in a systemaiic and essentially rigorous manner. The dynamical equations are rewritten as a sequence of linear integral equations for successtvely larger systems, each with a kernel and inhomogeneous term which can be calculaied explicitly from the solutions of the previous equaitons. The kernels arise from connecied graphs only, so each integral equation can be solved by the Fredholm, quastparticle, or other methods. The disioried wave approximation appears naturally in thts approach. One minor by-product is an explicit upper bound on the binding energy of any N-particle composite sysiem with square-integrable potentials. (Contractor's abstraci)

236

California U. [Dept. of Physics] Berkeley.

POLES IN COUPLED SCATTERING AMPLiTUDES, by A. J. Dragt and R. Karplus. [1963] [7]p (AFOSR-64-2444) (AF AFOSR-63-232) AD 453753 Unclassified

Alsc publtshed in Jour. Math. Phys., v. 5: 120-126, Jan. 1964.

Elastic scattering amplitudes which have the analytic structure of the Mandelstam representation and whtch satisfy the unttariiy condition and substituiion law are severely restric'ed. Because of these restrictions, poles cannot occur tndependently and arbitrarily tn ampliiudes coupled by the unttariiy condtttion. Instead, the locations and residues of poies in coupled ampltiudes musi satisfy the same relations as do poles tn periurbation theory ampliiudes. (Contractor's abstraci)

237

California U. [Dept. of Physics] Berkeley.

ORIGIN OF INTERNAL SYMMETRIES, by E. Abers, F. Zachariasen, and C. Zemach. [1963] [6]p. (AFOSR-64-2446) (AF AFOSR-63-232) AD 453751
                    Unclassified

Also published in Phys. Rev., v. 132: 1831-1836, Nov. 15, 1963.

Internal symmetries such as isotopic spin are not necessarily arbitrary constraints to be imposed at the beginning of a calculation. The bootstrap requirement that all particles be determined as composite states of one another leads naturally to symmetrtc solutions for masses and coupling constants. (Contractor's abstract)

238

California U. [Dept. of Physics] Berkeley.

CYCLOTRON RESONANCE IN SODIUM AND POTASSI-UM, by C. C. Grimes and A. F. Kip. July 23, 1963, 31p. (AF AFOSR-63-290) AD 430975   Unclassified

Azbel'-Kaner cyclotron resonance has been observed in oriented single crystals of sodium and potassium. The data are isotropic in both metals and yield for the ratio of cyclotron effective mass to free electron mass the values 1.24 ± 0.02 and 1.21 ± 0.02 for sodium and potassium respectively. The isotropy of the data for potassium indicates that its Fermi surface is nearly spherical with the anisotropy in kF probably less than 1%. The interpretation of the data for sodium ts complicated by the existence of a low temperature phase transformation. (Contractor's abstra~t)

239

California U. [Dept. of Physics] Berkeley.

WAVEMETERS FOR MILLIMETER WAVELENGTHS, by G. R. Gathers. 1963, 6p. (AF AFOSR-63-290) AD 415633   Unclassified

Improved wavemeters of simple design are described making use of confocal multimode resonators. Experiments are described evaluaiing design parameters and actual performance. (Contractor's abstract)

240

California U. [Dept. of Physics] Berkeley.

A COMPARISON OF AURORAL LUMINOSITY AND IONOSPHERIC ABSORPTION USING WIDE-ANGLE MEASUREMENTS, by R. R. Brown and J. R. Barcus. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-65-1876) (AF AFOSR-63-331)   Unclassified

Also published in Arkiv Geofysik, v. 4: 395-403, 1964.

A comparison of auroral lumtnosity variations over

the antenna pattern of the 27.6 mc/s rtometer at
College, Alaska, with ionospheric absorption records
indicates that tonospheric absorption is associated
principally with the post-breakup phase of auroras.
The lack of visible structure to the diffuse post-breakup
aurora suggests that the fluctuations in the relation be-
tween auroral absorption and geomagnetic disturbances,
as well as auroral luminosity and ionospheric absorp-
tion, are due to differences in the electron energy spec-
trum from event to event rather than spatial structure
of the particle bombardment. (Contractor's abstract)

241

California U. Dept. of Physics, Berkeley.

PHASE-SHIFT EQUATIONS FOR MANY-CHANNEL
PROBLEMS, by C. Zemach. [1964] [9]p. (AFOSR-
65-0493) (AF AFOSR-64-232) AD 614167
                                        Unclassified

Also published in Nuovo Cimento, Series X, v. 33:
936-947, Aug. 1, 1964.

First-order differential equations for phase shifts are
obtained for the many-channel case as a generalization
of Calogero's results for ordinary potential scattering
(see item no. 333, Vol. VI). (Contractor's abstract)

242

California U. [Electronics Research Lab.] Berkeley.

SPACE CHARGE INSTABILITIES IN ELECTRON
DIODES. II, by W. B. Bridges. Apr. 15, 1963 [10]p.
(AFOSR-64-0060) (AF 49(638)102) AD 431166
                                        Unclassified

Also published in Jour. Appl. Phys., v. 34: 2946-
2955, Oct. 1963.

A detailed analysis of space-charge instabilities in
diodes is presented. The oscillation when the input
current exceeds the limiting input current (from
earlier analysis for a short circuited diode with a
zero temperature stream) persists with the addition of
a diode resistance, or with a two-velocity input or a
Maxwellian velocity distribution input, or with streams
of finite diameter. The time-averaged value of the
minimum potential is nearly zero, as in the classical
solution; however, the time-averaged minimum position
and transmitted current differ considerably from the
classical values. The recovery of the stable state is by
a jump rather than gradually as in the classical solu-
tion. A small-signal prediction of time growth of all
first-order variables (potential, current, velocity) at
the point of limiting is given. An energy argument
using the zero-order variables is presented showing the
onset of instability. Experiments agreed with some
parts of the analysis but did not show oscillations with
amplitudes as large as expected. (Contractor's
abstract)

243

California U. Electronics Research Lab., Berkeley.

DIATOMIC GAS OPTICAL MASER WITH EXPLODING
WIRE PUMPING SOURCE, by L. Hajdu. June 5, 1963,
36p. (Rept. no. 63-12) (AF 49(638)102) AD 421806
                                        Unclassified

The feasibility of a gaseous maser in which the excited
atoms are produced through photochemical decomposi-
tion of diatomic molecules (such as nitrogen, oxygen
and nitric oxide) is studied. As an example, the photo-
dissociation of NO is discussed in detail. The calcula-
tions indicate that light oscillation may be achieved at
7468.8A and 8446A wavelengths. Because of the re-
quired high excitation energies, the useful pumping
band of such a system is in the extreme ultraviolet. Ex-
ploding wire is suggested as a suitable light source,
having very intense output in the vacuum ultraviolet,
with excellent reproducibility of its spectral character-
istics per flash. Preliminary experiments show that
when nitrogen and oxygen molecules are photoactivated
by the light output of an exploding wire, the 7468.8A
nitrogen and 8446A oxygen emission lines appear with
relatively high intensities.

244

California U. [Electronics Research Lab.] Berkeley.

ON THE GENERATION OF THE STABILITY CON-
STRAINTS FOR LINEAR DISCRETE SYSTEMS, by E. I.
Jury. [1962] [1]p. incl. tables. (AF AFOSR-62-70)
                                        Unclassified

Published in IEEE Trans. Automatic Control, v. AC-8:
184, Apr. 1963.

Recently, certain simplified analytic tests for linear
discrete systems (or stability within the unit circle)
have been developed. These tests can be of 3 forms,
i.e., the determinant, table, and the division methods.
In this note the stability constraints which are obtained
from the table or division method will be generated
without the use of the table or division. This generation
is based on simple rules which can be easily remembered
and applied. (Contractor's abstract)

245

California U. [Electronics Research Lab.] Berkeley.

SCATTERING OF HIGH-FREQUENCY WAVES BY
PERFECTLY CONDUCTING RECTANGULAR CYLIN-
DERS, by K. Mei. [1963] [5]p. (AFOSR-J1395)
(AF AFOSR-62-340) AD 428359   Unclassified

Also published in IEEE Internat'l. Conv. Rec., Pt. 1:
132-136, 1963.

Application of the geometric theory of diffraction in the
interpretation of the high-frequency phenomena is pre-
sented. The occurrences of resonances in the obstacles
are explained. The diffracted fields contributed by the

corners are shown to be much weaker than was to be expected. The total scattering cross-sections of rectangular cylinders are discussed. (Contractor's abstract)

246

California U. Electronics Research Lab., Berkeley.

ANALYSIS AND SYNTHESIS PROBLEMS IN SILICON INTEGRATED CIRCUITS, by D. O. Pederson. [1963] [5]p. incl. diagrs. refs. (AFOSR-J1396) (AF AFOSR-62-340) AD 428358   Unclassified

Also published in IEEE Internat'l. Conv. Rec., Pt. 2: 171-177, 1963.

Circuit problems with three circuit functions for S-1-C are discussed. These problems fall into the general topics of distributed, non-exact realizations of lumped, prototype circuits and of the lack of basic understanding of electron circuit functions. In common with earlier, conventional electronic circuit efforts, the work to be done can be separated into two areas. One area concerns the actual realization of a circuit, in this case a S-1-C, and at least initially will involve much empiricism. The other area of needed effort must deal with basic methods of analysis and design (synthesis being a sub-class of the latter). In the latter area, it is hoped that the circuit theorist of today and tomorrow will join the effort. (Contractor's abstract, modified)

247

California U. Electronics Research Lab., Berkeley.

REPORT ON EXPERIMENTS WITH THE OLFACTORY CORTEX OF THE CAT, by G. G. Furman. Jan. 17, 1964, 37p. incl. illus. diagrs. refs. (Rept. no. 64-1) (AFOSR-64-0318) (AF AFOSR-62-340) AD 430077
Unclassified

Experiments with the stimulation of the olfactory cortex of the cat were conducted with help of chronically implanted bipolar electrodes for recording and stimulation. The final response data were obtained by averaging 10 or more time responses so as to raise the signal-to-noise ratio. An analytic expression for the theoretical cortical response was obtained by means of a model which treats the primary cortical unit as a current generator of damped sinusoids. The theoretical curves, as generated by a digital computer, showed an excellent fit with some of the experimental curves. Some alternative theories are also discussed, as the present one was not shown to be a unique solution. Nevertheless, it was thought that because it utilizes a new technique of spatial summation in a neuronal tissue, it provides a realistic basis for the analysis of evoked cortical potentials. (Contractor's abstract)

248

California U. [Electronics Research Lab.] Berkeley.

FINDING THE MOST RELIABLE ROUTES IN COMMUNICATION SYSTEMS, by S. C. Parikh and I. T. Frisch. [1963] [5]p. incl. diagrs. (AFOSR-64-1581) (AF AFOSR-62-340) AD 446365   Unclassified

Also published in IEEE Trans. Commun. Systems, v. CS-11: 402-406, Dec. 1963.

It is shown that the problem of finding the most reliable route between two stations in a communication system can be reduced to the problem of finding the shortest path between two nodes in a weighted linear graph. The known methods for finding the shortest path in a linear graph are extended to apply to any communication system, and simplified algorithms and computer subroutines are presented. (Contractor's abstract)

249

California U. [Electronics Research Lab.] Berkeley.

DESIGN OF DUAL-REFLECTOR ANTENNAS WITH ARBITRARY PHASE AND AMPLITUDE DISTRIBUTIONS, by V. Galindo. Nov. 14, 1963, 6p. (AFOSR-64-2221) (AF AFOSR-62-340) AD 452293   Unclassified

Also published in IEEE Trans. Antennas and Propagation, v. AP-12: 403-408, July 1964.

A synthesis method based on geometrical optics for designing a dual-reflector antenna system with an arbitrary phase and amplitude distribution is the aperture of the second reflector is presented. The first reflector may be illuminated by a pattern with an arbitrarily curved phase front. A pair of first-order ordinary nonlinear differential equations of the form $dy/dx = f(x, y)$ are developed for the system. Questions concerning uniqueness, existence and bounds for the solutions can be answered. Calculations and numerical results for the design of a uniform amplitude and phase dual-reflector system are presented.

250

California U. Electronics Research Lab., Berkeley.

A STUDY OF LIMITATIONS ON THE CHARACTERISTICS OF NETWORK FUNCTIONS, by J. D. Patterson. Mar. 15, 1963, 44p. (Internal technical memo. no. M14) (AF AFOSR-62-340) AD 418706   Unclassified

An investigation is made of the general form of the limitations imposed on driving point and transfer immittances when some part of the input circuit of a network is fixed. The limitations are found to be bounds on the real and imaginary parts of the functions at points in the right half plane. At certain specific frequencies determined by the fixed part of the network, the values of the immittance function and some of its derivatives are fixed. These limitations on the values of immittance functions at points in the right half plane are then expressed in terms of integrals of the function along the

imaginary axis by means of Cauchy's integral formula. The limitations on integrals are utilized to find limitations on the characteristics of ideal immittance functions. Several examples are given to illustrate the use of these limitations. (Contractor's abstract)

251

California U. Electronics Research Lab., Berkeley.

FOCUSING OF AN ELECTRON STREAM WITH RADIO-FREQUENCY FIELDS, by C. K. Birdsall and G. W. Rayfield. [1964] [22]p. incl. diagrs. illus. refs. (AFOSR-65-1109) (AF AFOSR-63-117) AD 620690
Unclassified

Also published in Jour. Electron. and Control, v. 17: 601-622, Dec. 1964.

A cylindrical stream of electrons is focused solely by the fields of a slow electromagnetic wave. An analysis is obtained by transforming to the wave frame in which the equations of motion of electrostatic periodic focusing are valid. A second analysis is made by transforming to the electron frame and approximating the fields in order to compare fast-wave and slow-wave focusing. Several experiments are presented using a helix as the slow waveguide, and results are found to be in rough agreement with theory.

252

California U. Electronics Research Lab., Berkeley.

JOINT SERVICES ELECTRONICS PROGRAM, by D. O. Pederson and J. R. Whinnery. Final rept. Feb. 15, 1963-Feb. 14, 1964. Mar. 31, 1964, 44p. incl. refs. (Rept. no. 64-13) (AFOSR-64-0900) (AF AFOSR-63-139) AD 600049; AD 603736   Unclassified

Research efforts in the following areas are summarized: bioelectronics (electrophysiological properties of the nervous system, hydration studies including dielectric constant measurement of xenon-hemoglobin association compounds); circuit theory (passive network synthesis, active circuits, time-varying networks); electron streams and interactions (microwave amplifiers, noise and instabilities, emission, trajectories); plasmas (magnetic-mirror compression, homo-polar rotating plasmas. low-energy plasmas); radiation and propagation (electromagnetic scattering from conducting loops, microwave scatter from a rough water surface, dual reflect on synthesis techniques, surface waves, frequency-independent antennas); solid-state electronics (integrated circuits, materials and mechanisms); systems (control systems, communication systems). Research papers, talks, reports and memoranda sponsored by JSEP are listed.

253

California U. Electronics Research Lab., Berkeley.

PROPAGATION IN GENERALIZED GYROTROPIC

MEDIA, by V. H. Rumsey. [1964] [4]p. (AFOSR-64-1129) (AF AFOSR-63-139) AD 441842
Unclassified

Also published in IEEE Trans. Antennas and Propagation, v. AP-12: 83-86, Jan. 1964.

Generalized gyrotropic media are characterized by four axes, three being the principal axes of the anisotropic media before application of the steady magnetic field H(O) and the fourth being the direction of H(O). They can be synthetically fabricated from an appropriately stratified pile of ferrite rods. Although much more complicated than for ordinary gyrotropic media the basic modes of radio propagation in such generalized media turn out to have some surprisingly simple properties. Formulas for these characteristic polarizations in terms of the tensor permeability are also very simple. (Contractor's abstract)

254

California U. Electronics Research Lab., Berkeley.

NOTES ON SYSTEM THEORY, VOLUME V. Apr. 1964, 124p. incl. diagrs. tables, refs. (Rept. no. 64-8) (AFOSR-64-1350) (AF AFOSR-63-139 and AF AFOSR-63-292) AD 601993   Unclassified

This report contains the following: Digitalization of continuous control systems, by M. A. Breuer; Some theorems on combining linear inequalities, by M. A. Breuer; A conjecture on the properties RC-RL networks, by D. A. Calahan; A gain-bandwidth limitation for an n-varactor parametric amplifier, by M. Fukada; On the equivalence partitioning of linear modular circuits, by A. Gill; A note on correction to a result of Dobrushin, by B. Gluss; A remark about invertible boolean functions, by M. A. Harrison; On the asymptotic number of automata, by M. A. Harrison; Time-varying networks-the state variables and stability, by E. S. Kuh; Sufficient conditions for the existence of a solution to a continuous linear programming problem and a corresponding duality theorem, by A. Larsen; A minimal representation for a cascade of lattice networks, by D. M. Layton and I. T. Frisch; Equilibrium controllability and stability of N.P.F.M. control systems, by T. Pavlidis; and On the evaluation of optimal and non-optimal control strategies, by E. Polak.

255

California U. [Electronics Research Lab.] Berkeley.

A BACKWARD-WAVE SURFACE MODE IN A PLASMA WAVEGUIDE by R. N. Carlile. [1964] [8]p. incl. illus.   . (AFOSR-64-1373) (AF AFOSR-63-139) AD 44   . .   Unclassified

Also published in Jour. Appl. Phys., v. 35: 1384-1391, May 1964.

The phase characteristics of a backward-wave passband mode have been measured in a plasma waveguide, consisting of a circular waveguide that is coaxial with the positive column of a mercury-vapor discharge. The

mode has been identified as an n = 1 surface mode
similar to that described by Trivelpiece. It is shown
that zero-temperature plasma-wavegutde theory pre-
dicts this mode accurately. This theory predicts that
a simple relation exists between the lower cutoff fre-
quency of the n = 1 mode and the electron plasma fre-
quency. It is demonstrated that the calculated electron
plasma frequency obtained from this relation, where
the cutoff frequency is determined from a measurement
of the phase characteristics, agrees well with an inde-
pendent measurement of electron plasma frequency by
the well-known cavity-perturbation method. Both the
n = 1 and symmetric n = 0 modes were excited by a
novel coupler called the double-ring coupler. Noise
measurements on the n = 1 and symmetric n = 0 modes
indicate that the output signal-to-uoise ratio is inde-
pendent of input signal power and is about 7 dB for the
n = 1 mode and varies from about 7 to greater than 30
dB for the n = 0 mode. A simple model of the plasma
is proposed which explains all the noise observations
reported here. (Contractor's abstract)

256

California U. Electronics Research Lab., Berkeley.

DOMINANT ZERO AND EXCESS PHASE OF A
HURWITZ POLYNOMIAL, by D. O. Pederson and G. H.
Wilson. [1964] [5]p. incl. diagrs. (AFOSR-64-1374)
(AF AFOSR-63-139) AD 444473   Unclasstfied

Also published in IEEE Trans. Ctrcutt Theory, v.
CT-11: 104-108, Mar. 1964.

In the analysis and design of linear electronic circuits,
it is often necessary and desirable to restrict attention
to first-order effects only. Simplifications of the cir-
cuit may take the form of a dominant natural frequency
(or time-constant) description. That ts, of the total
natural frequencies of the circuit, one may be found to
be dominant over a frequency or time interval of
interest. For the low-pass situation, necessary condi-
tions are presented in this paper to establish the domi-
nant zero of a polynomial in terms of the coefficients
of the polynomial. Simple expressions are also given
to estimate the second-order effect of excess phase
(or dead time). A simple transistor amplifier is used
as an example. (Contractor's abstract)

257

California U. Electronics Research Lab., Berkeley.

SYNTHESIS OF DUAL REFLECTOR ANTENNAS, by
V. Galindo. July 30, 1964, 275p. incl. diagrs. refs.
(Rept. no. 64-22) (AFOSR-64-1583) (AF AFOSR-63-
139) AD 445821   Unclassified

A synthesis method based on geometrical optics for
designing a dual reflector antenna system with an
arbitrary phase and amplitude distribution in the
aperture of the second reflector ts presented. The
first reflector may be illuminated by a pattern with an
arbitrarily curved phase front. A pair of first order
ordinary nonlinear differential equations of the form
dy/dx = f(x, y) are developed for the system. Questions

concerntng untqueness, existence, and bounds for the
solutions are discussed. Calculations and numerical
results for the destgn of a uniform amplitude and phase
dual-reflector system are presented. The diffraction
effects of the small reflector are analyzed by the
methods of geometrical diffraction. Their effects upon
the aperture distribution of the larger reflector are
analyzed in detatl. Correction for the small reflector
diffracted field is obtained partially by an iterative pro-
cedure utilizing the above synthesis method. The tenta-
tive conclusion was drawn after extensive numerical
analysis that complete correction for the diffraction
effects is not possible. (Contractor's abstract)

258

California U. Electronics Research Lab., Berkeley.

ON THE POSSIBILITIES OF DETECTION OF PERIODIC
DISTURBANCES ON A ROUGH SURFACE USING RADIO
TECHNIQUES, by R. H. Clarke. May 29, 1964, 37p.
tncl. diagrs. tables, refs. (Rept. no. 64-21) (AFOSR-
64-1906) (AF AFOSR-63-139) AD 448493
                        Unclassified

The theory of reflection of electromagnetic waves from
a moving sinusoidal disturbance, on both rough and still
water, is presented in a simple approximate form. It
is shown that the detection of such a disturbance is, tn
principle a practical possibility. Some of the require-
ments of such a detection system are briefly discussed.
The basts of the simplified theory is discussed in de-
tail, and new experimental results are presented to
demonstrate the validity of the approach used. (Con-
tractor's abstract)

259

California U. Electronics Research Lab., Berkeley.

A STABILITY CRITERION FOR TUNNEL DIODES, by
I. T. Frisch. [1964] [2]p. (AFOSR-64-2139) (AF
AFOSR-63-139) AD 452270   Unclassified

Also published in Proc. IEEE, v. 52: 922-923, Aug.
1964.

Given the complete linear equivalent circuit of a tunnel
diode, a new sufficient condition is presented for the
diode to be potentially stable, where the diode is po-
tentially stable if all open circuit natural frequencies
can be shifted to the left half of the complex frequency
plane, by properly imbedding the tunnel diode in a two
terminal passive network. (Contractor's abstract)

260

California U. Electronics Research Lab., Berkeley.

A LINEAR SEARCH PROBLEM, by E. Wong. [1964]
[7]p. (AFOSR-64-2224) (AF AFOSR-63-139)
AD 452417   Unclassified

Also published in SIAM Rev., v. 6: 168-174, Apr. 1964.

A class of one-dimensional search problems is considered. In general, the formulation results in a functional-minimization equation of the dynamic programming type. In a special case the optimal solution for both the objective and policy have been found. (Contractor's abstract)

261

California U. [Electronics Research Lab.] Berkeley.

ON THE REDUCTION OF THE SYSTEM $\chi = Bx + Bu$, $y = c'\chi$ TO ITS MINIMAL EQUIVALENT, by H. Kwakernaak and E. Polak. [1963] [2]p. (AFOSR-64-2225) (AF AFOSR-63-139) AD 452264 Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-10, Dec. 1963.

A method is proposed for constructing minimal scalar and vector representations for systems of the form given in the title. A situation where one might be interested in finding a minimal equivalent is the problem of synthesizing a multiple-input, single-output system which is specified as above. Before the system is built, it is usually desirable to reduce it to its simplest form, namely, its minimal equivalent. (Contractor's abstract)

262

California U. Electronics Research Lab., Berkeley.

TECHNIQUES FOR AUTOMATING THE CONSTRUCTION OF TRANSLATORS FOR PROGRAMMING LANGUAGES, by W. H. Wattenburg. Jan. 13, 1964, 16p. (Rept. no. 64-45) (AFOSR-f5-0264) (AF AFOSR-63-139) AD 609487 Unclassified

Formal procedures are summarized for constructing translators where by a computer is used to generate substantial portions of the translators, the latter being termed symbolic machine language assemblers, macro expanders, or compilers. The translators all perform the task of translating programs written in one language into equivalent programs written in another. BASIC BOOTSTRAP PROCEDURE: The first translators were written in an available machine language and were mostly symbolic machine language translators (assemblers). Application of the 'bootstrap' procedure was the writing in symbolic language, including the translator itself, of programs, once a symbolic machine language translator became available for a particular machine. The bootstrap procedure has the property that each translator can translate its own description into itself since it is described by a language which is a subset of the language it translates. The NELIAC, compiler for the Remington Rand M460 is a 'self-compiling compiler'. MULTIPLE BOOTSTRAP PROCEDURES: These procedures involve translators producing object programs for machines other than the machine that performed the translation. As an example of the use of an intermediate language and multiple bootstrap procedure, there is cited the translator constructed for the FORTRAN language and the IBM-7090

and CDC-3600 computers by Mendicino, Storch, and Sutherland at the Lawrence Radiation Lab. of California U.

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California U. Electronics Research Lab., Berkeley.

LASER-INDUCED EMISSION OF ELECTRONS, IONS, AND NEUTRALS FROM Ti AND Ti-D SURFACES, by T. Y. Chang and C. K. Birdsall. [1964] [2]p. incl. diagrs. (AFOSR-65-0910) (AF AFOSR-63-139) AD 617233 Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 171-172, Nov. 1, 1964.

This note describes the plasma produced from deuterated titanium disks due to laser-induced emission. Three representative experiments are described, and it is proposed that the target surface temperature produced by an unfocused laser beam is highly nonuniform; the large directed ion energy produced by a focused laser beam is of the order predicted by hydrodynamic blow off theory; and the fast ion pulse produced by a focused laser beam is postulated as secondary emission at the collector due to fast D_2 molecules blown off the target surface.

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California U. Electronics Research Lab., Berkeley.

SHEET-CURRENT PLASMA MODEL FOR ION-CYCLOTRON WAVES, by A. Hasegawa and C. K. Birdsall. [1964] [11]p. incl. diagrs. tables, refs. (AFOSR-65-0911) (AF AFOSR-63-139) AD 617234 Unclassified

Also published in Phys. Fluids, v. 7: 1590-1600, Oct. 1964.

An appropriate plasma model, using current sheets, is introduced and initial results are presented. The primary utility is to obtain the nonlinear behavior of ion-cyclotron waves. Linear analysis is used to develop the bicircular particle motion, to show the coupling of the ion-cyclotron resonance for finite $T_{\parallel}$, to show Landau cyclotron damping for finite $T_{\parallel}$. The sheet model is developed in terms of vector potential A and sheet current density J_s for k parallel to the steady field B_0. There are transverse fields only, with sheet motion along 3 coordinates. The electrons are assumed to be hot, forming a neutralizing background. The model accuracy tests show a reasonable duplication of cold plasma ion waves. The first computer experiment shows wave damping for $T_{\parallel} \gg T_{\perp}$ at the rate expected from linear analysis, and with $T_{\parallel}$ decreasing, T_i decreasing, and $T_{\parallel}$ increasing. The third computer experiment was to find the limit in $T_{\perp}$ for interaction with an electron stream for $\omega \sim \omega_{ci}$; the nonlinear limit, with equal transverse energies, substantially exceeds the linear analysis result, lending encouragement to this means of ion heating.

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California U. Electronics Research Lab., Berkeley.

OPTIMAL CONTROL OF SYSTEMS WITH STOCHASTIC
DISTURBANCES, by R. Sussman. Nov. 25, 1963, 69p.
(AF AFOSR-63-139) AD 430078   Unclassified

The optimal control of a linear system which is
disturbed by white (or linear Markov) additive noise is
discussed. The state of the system cannot be measured
directly, but is corrupted by additive white (or linear
Markov) noise. The cost function used is quadratic. It
is proved that the optimal controller is a linear function
of the observations only if both noises are Gaussian.
This implies that the minimal cost of controlling this
system, when subjected to Gaussian noise, is strictly
higher than when subjected to any non-Gaussian noise,
which has the same second order properties as the
Gaussian. Besides this proof, Kalman's best linear
optimal controller is extended to a polynomial controller.
This controller retains the same features as Kalman's
best linear controller; namely, only the first few mo-
ments of the best estimate must be updated as the
process evolves. While the optimal linear controller
requires the updating of only the mean and the variance,
the n-th order polynomial controller requires the up-
dating of the 2n first moments. These results can also
be applied to optimal filtering. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

REALIZABILITY OF n-PORT RESISTIVE NETWORKS
WITH MORE THAN (n + 1) NODES, by K. R.
Swaminathan and I. T. Frisch. July 14, 1964, 37p.
(Rept. no. 64-23) (AF AFOSR-63-139) AD 450736
                                    Unclassified

A new set of necessary conditions are presented for
an nth order square symmetric matrix with real entries
to be the n-port admittance matrix of a network con-
taining positive resistors and more than (n + 1) nodes.
(Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

THEORY AND MEASUREMENT OF A SURFACE
WAVEGUIDE, by D. E. Norton. Nov. 25, 1963, 98p.
(AF AFOSR-63-139) AD 430079   Unclassified

A surface waveguide, which consists of a dielectric
slab backed by a perfect conductor lying between and
perpendicular to two parallel conducting planes, is
excited by a slot source at a frequency of 9,339 mc.
The resulting electromagnetic fields are obtained both
experimentally and analytically. The fields are meas-
ured by the reflection from a thin metal cylinder and
this technique is shown to be accurate within one db
for test cases with no dielectric present. (Contractor's
abstract, modified)

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California U. Electronics Research Lab., Berkeley.

TIME-VARYING GC NETWORKS, by A. Paige.
Oct. 11, 1963, 114p. (Rept. no. 63-25) (AF AFOSR-
63-139) AD 430076   Unclassified

The purpose of this investigation is to study the proper-
ties of time-varying G-C networks. These networks
are constructed from one of the following models:
(1) A number of resistances and capacitances can have
their values altered mechanically (e.g., rheostats
and variable capacitors) and are driven by some me-
chanical agency. (2) The study of the stability of non-
linear networks can usually be reduced to a study of
stability of a linear equation which describes a small
perturbation about some equilibrium state of the non-
linear network. This linear equation will, in general,
have coefficients which are functions of time. If the
type of elements in the nonlinear network are suitably
restricted, the linear perturbation equation can be
interpreted as describing the operation of a linear time-
varying conductance-capacitance network. (Contractor's
abstract)

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California U. Electronics Research Lab., Berkeley.

TIME-VARYING NETWORKS - THE STATE VARIABLES,
STABILITY AND ENERGY BOUNDS, by E. S. Kuh.
Mar. 1964, 30p. (Rept. no. 64-10) (AF AFOSR-63-
139) AD 435839   Unclassified

This paper is concerned with linear networks which
contain time-varying resistors, inductors, and capaci-
tors. The state variables formulation is used to de-
scribe the general circuit. The energy stored is calcu-
lated in terms of the state variables and the incidence
submatrices from which general sufficient conditions
for stability are derived. Upper and lower bounding
functions on the stored energy are next obtained. These
functions lead to sharply defined conditions for stability
and instability of periodically varying networks. Exam-
ples are included to illustrate the use of the general
method and the importance of the results. (Contractor's
abstract)

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California U. Electronics Research Lab., Berkeley.

THE PROBLEM OF IDENTIFICATION OF DISCRETE-
TIME PROCESSES, by C. A. Galtieri. Dec. 27, 1963,
129p. incl. tables, refs. (Rept. no. 63-19) (AFOSR-
64-1197) (AF AFOSR-63-292) AD 603739
                                    Unclassified

A logical framework is proposed within which the prob-
lem of identification of discrete-time processes may be
defined in a precise and general way. The general solu-
tion is then derived and some of its most important
applications are discussed in some detail. The report
is essentially divided in 3 parts. In the first a well-
defined language is introduced in order to be able to

state the problem in an unequivocal way. The basic axioms and definitions of this part lead to the general results of which the following chapters are specialized applications. In the second part the problem of identification of discrete-time processes is specifically included and some of its general aspects are discussed. The final part discusses in some detail a number of specific cases of particular importance. Particular attention was given to the problem of estimating the coefficients of a difference equation. It is shown that two previously proposed methods of solution for this problem may be considered as approximations of the method proposed in this report. The numerical solution of some very simple examples is included for purposes of illustration. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

ON THE STABILITY OF A CERTAIN CLASS OF NONLINEAR SAMPLED-DATA SYSTEMS, by E. I. Jury and B. W. Lee. [1964] [11]p. incl. refs. (AFOSR-64-1316) (AF AFOSR-63-292) AD 444141
Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-9: 51-61, Jan. 1964.

A sufficient condition for stability of a class of sampled-data feedback systems containing a memoryless, nonlinear gain element is obtained. In this paper, the stability criterion embodied in this theorem can be readily obtained from the frequency response of the linear plant. This method is essentially similar to Popov's method applied to the study of nonlinear continuous systems. Furthermore, Tsypkin's results for the discrete case are obtained as a special case when $q = 0$. Several examples are discussed, and the results are compared with Lyapunov's quadratic and quadratic plus integral forms as well as with other methods. For these examples, the results obtained from the new theorem yield less conservative values of gain than Lyapunov's method. Furthermore, for certain linear plants the new theorem also yields the necessary and sufficient conditions. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

A NOTE ON THE RECIPROCAL ZEROS OF A REAL POLYNOMIAL WITH RESPECT TO THE UNIT CIRCLE, by E. I. Jury. Nov. 18, 1963, 2p. (AFOSR-64-1822) (AF AFOSR-63-292) AD 449251   Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-11: 2, June 1964.

The purpose of this communication is to present a precise formulation of a theorem proposed by Marden which is related to the existence of reciprocal zeros with respect to the unit circle and to indicate a rule which is simpler than Cohn's for determining the number of the reciprocal zeros with respect to the unit circle of a real polynomial. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

ON THE ABSOLUTE STABILITY OF NONLINEAR SAMPLED-DATA SYSTEMS, by E. I. Jury and B. W. Lee. [1964] [4]p. incl. diagrs. (AFOSR-65-1011) (AF AFOSR-63-292) AD 619108   Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-9: 551-554, Oct. 1964.

A general form of area inequality is used to develop a frequency domain criterion for absolute stability of single-nonlinear sampled-data (SNSD) systems. By reductions of the general form to specific area inequalities, it is suggested that all known and some new frequency domain criteria applicable to different subclasses of SNSD systems may be derived as special cases. One of the latter involving $q < 0$ is investigated to determine its significance and general applicability to SNSD systems. An example of a SNSD system with dead zone is used to illustrate some of the results presented.

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California U. Electronics Research Lab., Berkeley.

SYNCHROTRON RADIATION MEASUREMENTS FROM A HOT ELECTRON PLASMA, by A. J. Lichtenberg, S. Sesnic, and A. W. Trivelpiece. Aug. 17, 1964, 32p. incl. illus. diagrs. refs. (Rept. no. 64-28) (AFOSR-65-0266) AD 454768   Unclassified

The synchrotron radiation emanating from a hot-electron plasma produced in a pulsed magnetic mirror field has been measured. The measurements were made with a 1 u sec time constant InSb detector with a frequency response covering the wavelengths between 4 mm and 0.1 mm. For peak fields which were varied between 30 and 60 kG with corresponding electron temperatures between 25 and 50 kev the radiation was found to be greater than 0.1 mW/ster at the low field and greater than 1.0 mW/ster at the high field. This variation was consistent with that calculated by integrating the radiation from a single electron over a two dimensional, relativistic Maxwellian with the appropriate temperature. The calculation, together with the measured radiation amplitude, was used to determine the total number of radiating electrons. Preliminary results on the spectral distribution of the radiation were obtained. The decay of the radiated power is closely correlated with microwave radiation and other diagnostics both in regimes and those in which the plasma developed an instability. (Contractor's abstract, in part)

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California U. [Electronics Research Lab.] Berkeley.

A REMARK ON UNIFORM DISTRIBUTION, by M. A. Harrison. [1964] [1]p. (AFOSR-65-0334) (AF AFOSR-64-639) AD 611926   Unclassified

Also published in IEEE Trans. Electron. Comput.,
v. EC-13: 1, Oct. 1964.

This paper refers to a previous publication by D. C.
Fielder (IEEE Trans. Electron. Comput., v. EC-13:
53-54, Feb. 1964) on the study of uniform distribution
of contacts in relay trees. The determination of
$\{n/2^n \equiv 3 \mod (n-1)\} = Fn$ is made in particular.

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California U. Electronics Research Lab., Berkeley.

NOTES ON SYSTEM THEORY. VOLUME VI. Aug.
1964, 121p. incl. diagrs. refs. (Rept. no. 64-8)
(AFOSR-65-0632) (AF AFOSR-64-292, AF AFOSR-64-
230, and AF AFOSR-64-639) AD 611083
Unclassified

This report contains the following articles: On de-
composition techniques applied to the solution of linear
programming problems; On a theorem for nonlinear
networks; A note on the identification of a class of non-
linear time-invariant systems; A stability criterion ob-
tained by comparison; Relational equivalence of se-
quential machines; The conversational method of syn-
thesis for finite automata; A galois field multiplier;
On the inverse of the Lyapunov operator; A real fre-
quency stability criterion containing periodically time-
varying capacitances and resistances; A note on polar
decomposition and the generalized inverse of an arbi-
trary matrix; Reduction of a linearly separable pattern
set to a minimum distance problem; On a combinatorial
theorem and applications; On nonlinear differential equa-
tions with delta functions driving forces; and A new
proof of the Wang algebra for networks.

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California U. [Inst. of Engineering Research] Berkeley.

SHOCK-WAVE STRUCTURE IN A PARTIALLY
IONIZED GAS, by M. S. Grewal and L. Talbot. [1963]
1v. (AFOSR-J1456) (AF 49(638)502) AD 427719
Unclassified

Also published in Jour. Fluid Mech., v. 16: 573-594,
1963.

The structure of a shock wave in a partially ionized
gas, which may be in thermal nonequilibrium ahead of
the shock wave, is investigated. A method is developed
to solve this problem by separating it into two parts.
First, the structure of the shock wave associated with
the massive particles, ions and atoms, is assumed to
be of the Mott-Smith form. Then the behavior of the
electrons as they pass through this shock is analyzed.
Using this method, calculations are carried out for
shock waves at several Mach numbers and several
values of the electron-ion temperature ratio ahead of
the shock. An essential feature of the shock profiles
is found to be the existence of a broad zone of elevated
electron temperature ahead of the electron compression
region, caused by the high thermal conductivity in the
electron gas. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

EFFECTS OF CHARGED PARTICLES ON THE
MOTION OF AN EARTH SATELLITE, by C. L. Brundin.
[1963] [10]p. incl. diagrs. table, refs. (AFOSR-64-
1951) (AF 49(638)502 and Nonr-22245) AD 432675;
AD 450323 Unclassified

Also published in AIAA Jour., v. 1: 2529-2538, Nov.
1963.

Using a model of the upper atmosphere in which the
principal atmospheric constituent (for both atoms and
ions) changes with increasing altitude from atomic
oxygen to helium and then to atomic hydrogen, the
charge on a conducting spherical satellite and the drag
due to charged particles are estimated for altitudes be-
low the hydrogen region. The effects of photoelectric
emission and the earth's magnetic field are included in
the calculations. It is found that the contribution of
charged particles to the satellite drag may be neglected
in the oxygen region. In the helium region the drag due
to charged particles may be significant, particularly
for large satellites and in cases where the photoelectric
emission current is significant. A method of estimating
this drag is presented. (Contractor's abstract, modi-
fied)

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California U. Inst. of Engineering Research, Berkeley.

SPECTROSCOPIC STUDY OF ELECTRON RECOMBINA-
TION WITH MONATOMIC IONS IN A HELIUM PLASMA,
by F. Robben, W. B. Kunkel, and L. Talbot. [1963]
[9]p. (AF 49(638)502) AD 432674 Unclassified

Also published in Phys. Rev., v. 132: 2363-2371,
Dec. 15, 1963.

Recent work on electron-ion recombination has shown
that a model including recombination into highly excited
bound levels through electron-electron-ion collisions
and transitions between the bound levels through elec-
tron-atom collisions as well as the usual radiative transi-
tions, is in good agreement with experiments in which
processing involving molecular ions, etc., are unim-
portant. By making absolute intensity measurements
of the lines of helium emitted from the decaying plasma
of an arc jet in the visible and near ultraviolet, the
number densities of the excited states of helium have
been calculated. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

A SPECTROSCOPIC STUDY OF RECOMBINATION
IN A HELIUM PLASMA, by F. A. Robben. Apr. 5,
1963, 48p. (Rept. no. HE-150-211; series no. 132,
issue no. 7) (AF 49(638)502) AD 405814
Unclassified

Recent work on ion-electron recombination has shown

that a model involving recombination into highly excited bound levels through electron-electron-ion collisions and transitions between the bound levels through electron-atom collisions as well ss the usual radiative processes, is in good agreement with experiment. By making absolute intensity measurements of all the lines of helium emitted from the decaying plasma of an arc jet in the visible and near ultraviolet, the number densities of the excited states of helium were calculated. When interpreted by means of the collisional-radiative recombination model, these measurements give values for the collisional de-excitation rate constant of an excited helium atom from level n to n - 1. The values of this constant are in reasonable agreement with a recent theory of classical excitation cross sections.

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California U. [Inst. of Engineering Research] Berkeley.

SIGNIFICANCE OF DETONATION STUDY TO PROPULSION DYNAMICS, by A. K. Oppenheim and A. J. Laderman. 1963, 1v. (AFOSR-J1090) (AF AFOSR-83-129) AD 421130   Unclassified

Presented at Fourteenth Cong. Internat'l. Astron. Fed., Paris (France), Sept. 1963.

The various means by which detonation study can influence the development of propulsion systems are discussed. The wave, besides the possibility of its actual appearance in the course of anomalous operation the combustion chamber, or its direct exploitation as the actual combustion front in an engine specially designed for this purpose, provides the prime experiment facility for the study of non-steady gasdynamics of systems characterized by a high rate of energy release. Moreover, it offers an insight into the relationship between the chemico-kinetic and gasdynamic phenomena that occur in thrust chambers not only during transient processes but also at steady state operation. Its theoretical aspects provide a stimulus to the development of gas-wave-dynamics, the subject dealing with the analysis of wave interaction processes, whose techniques are applicable not only to chemical propulsion systems, but also to gaseous nuclear devices and pulsed plasma accelerators. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

RECENT PROGRESS IN DETONATION RESEARCH, by A. K. Oppenheim, N. Manson, and G. G. Wagner. [1963] [10]p. incl. illus. diagrs. refs. (AFOSR-64-0894) (AF AFOSR-83-129) AD 439884
                                                    Unclassified

Presented at AIAA Summer meeting, Los Angeles, Calif., June 17-20, 1963.

Also published in AIAA Jour., v. 1: 2243-2252, Oct. 1963.

The major effect of currently conducted detonation studies is concerned mainly with three fundamental

problems: the development of the wave, its stability, and structure. The three are of course not independent of each other, and even the order of presentation is of some importance, for one cannot describe the structure without considering the stability, which, in turn, is related to the mode of development. Consequently this review consists of three corresponding parts, each written, respectively, by one of the authors in a different country, thus giving the subject matter an elucidation from three quite different points of view. Because of its particular significance to the process of combustion in a rocket thrust chamber, the scope is restricted to the gaseous phase. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

LONG-DURATION SPARK LIGHT SOURCE FOR STREAK SCHLIEREN PHOTOGRAPHY OF HIGH-SPEED EVENTS, by G. J. Hecht, C. T. Lilleston, and A. K. Oppenheim. [1964] [8]p. incl. illus. diagrs. refs. (AFOSR-64-1872) (AF AFOSR-83-129) AD 447590
                                                    Unclassified

Also published in ISA Trans., v. 3: 100-107, Apr. 1964.

A long-duration (up to 1.5 msec) light source is described which is suitable for schlieren photography of high-speed events. The source consists of a small area, open-air spark gap excited by a delay line network to produce substantially constant light intensity during the period of discharge. The very low sparkgap impedance is matched successfully by employing high-capacity photoflash type electrolytic capacitors operating at relatively low voltage. Indicated also are methods that make triggering reliable and reproducible. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

PRESSURE WAVE GENERATED IN A FISSIONABLE GAS BY NEUTRON IRRADIATION, by H. P. Smith, Jr., C. W. Busch, and A. K. Oppenheim. [1964] [8]p. incl. diagrs. (AFOSR-64-2031) (AF AFOSR-63-129) AD 451227   Unclassified

Also published in Phys. Fluids, v. 7: 878-883, May 1964.

An experiment is proposed to study the nonsteady gasdynamic phenomena produced by neutron induced exothermic nuclear reactions in a gaseous medium. The problem is formulated in terms of a set of characteristic equations in a time dependent, spatially unidimensional system and solved by means of a simplified analysis leading to a system of two first order, nonlinear, ordinary differential equations. The problem involves the generation of a pressure wave in a long tube filled with a boron trifluoride, fully enriched in the boron-10 isotope. The analysis predicts that the gas residing initially in the core will be heated to approximately $3000°K$ and that a compression wave with a peak pressure ratio of approximately 3 will

emanate from the reactor and coalesce into a shock of Mach number 1.8 at a distance of approximately 17 ft from the reactor core. Measurement of the pressure wave should provide information on the amount of reversible heating that can be obtained from a gaseous nuclear reaction. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

CALCULATION OF AERODYNAMIC FORCES ON CYLINDRICAL SHELLS IN UNSTEADY SUPERSONIC FLOW, by R. A. Brown and M. Holt. Apr. 1963 [26]p. incl. diagrs. tables. (Rept. no. AS-63-1) (AFOSR-5158) (AF AFOSR-63-266) AD 416375
                                                    Unclassified

The aerodynamic forces resulting from the vibration of a cylindrical shell of finite length in a supersonic stream have previously been calculated and using the static approximation. In this the flow field is determined as though it were steady in the state frozen at a given instant. In the present report the static approximation is improved and account is taken of first order effects in vibration frequency. This causes a phase shift between the shell displacement and the corresponding pressure or aerodynamic force coefficient. The phase shift varies with distance along the cylinder, the phase angle changing very rapidly in the neighborhood of zero of certain modified Bessel functions and remaining sensibly constant in between. The influence of this phase shift on panel flutter characteristics is expected to be significant and will be considered in subsequent reports. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

COMPUTATION OF GASEOUS DETONATION PARAMETERS, by C. W. Busch, A. J. Laderman, and A. K. Oppenheim. Aug. 1964, 109p. (Technical note no. 6) (AFOSR-64-1891) (AF AFOSR-64-129) AD 607360
                                                    Unclassified

This report describes the development of a method programmed for a digital computer to evaluate one-dimensional detonation parameters in gaseous media. The calculations are based on the assumptions that the wave process is governed by equilibrium end conditions. Details of the analytical method of solution are presented including the IBM 7090 computer program, described in Fortran language. Sample input and output data with instructions for preparing the input data are given. Finally, computations are performed for a number of hydrogen-oxygen mixtures from $H_2 + O_2$ to $3H_2 + O_2$ at several initial conditions covering a range in pressure from 0.1 to 760 mm Hg and in temperatures from -160 to +200°F and a comparison is made with calculations of other investigators for a stoichiometric mixture initially at NTP. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

DYNAMIC PERFORMANCE OF PRESSURE TRANSDUCERS IN SHOCK AND DETONATION TUBES, by W. E. Amend, A. J. Laderman, and A. K. Oppenheim. Sept. 1964, 158p. (Technical note no. 9) (AFOSR-64-1892) (AF AFOSR-64-129) AD 607361 Unclassified

A method is presented for evaluating the dynamic performance of high frequency pressure transducers on the basis of records obtained by means of shock tube calibration tests. The transducer's frequency response is determined from a Fourier transform analysis. The computations were programmed for the IBM 7090 computer including provision for the use on the cal-comp plotter to produce results describing the frequency dependence of the amplitude ratio, phase angle shift, and time lead between the output and input signal. Performance characteristics were calculated for several typical transducers, demonstrating the utility of the method in delineating frequency regimes where reliable response of the instrument can be expected. A number of commercial pressure transducers were tested in shock and detonation tubes. Records obtained from the former provide information on the natural frequencies and rise times of the sensors, while results of the latter were used to illustrate the effects of rapidly varying pressures and temperatures on the performance of the instruments. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

VECTOR POLAR METHOD FOR THE EVALUATION OF WAVE INTERACTION PROCESSES, by A. K. Oppenheim, P. A. Urtiew, and A. J. Laderman. [1964] [55]p. incl. diagrs. tables, refs. (AFOSR-65-1479) (AF AFOSR-64-129) AD 822643 Unclassified

Also published in Arch. Budowy Maszyn, v. 11: 441-495, 1964.

Vector polar method is a graphical technique for the solution of wave interaction problems that are concerned with the overall results rather than with the progress of the process. The method is based on the use of wave polars. If the ratio of pressures or sound speeds is represented on a logarithmic scale, usually as the ordinate, while the abscissa represents the change in particle velocity across the wave in a linear scale, then such a generalized hodograph plane has the property of a vector field. By simple vector addition, some quite complex wave interaction processes can then be rapidly evaluated. The utility of the method is illustrated by a variety of shock-tube problems involving interactions between shocks, deflagrations, rarefaction waves, contact discontinuities and area change. Although the analysis of most of such problems is known, the application of the vector polar method led to the discovery of some interesting regimes of solutions that would be difficult to discern by the more laborious conventional techniques. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

ON THE DYNAMICS OF THE DEVELOPMENT OF
DETONATION IN A GASEOUS MEDIUM, by A. K.
Oppenheim. [1964] [22]p. incl. illus. diagrs. table,
refs. (AFOSR-65-1480) (AF AFOSR-64-129)
AD 622842   Unclassified

Also published in Arch. Mech. Stosowanej., v. 2: 403-
424, 1964.

An elementary gasdynamic treatment is made of two
problems of detonation analysis: (1) the generation of
the pressure wave by the flame kernel, and (2) the
interaction between various pressure waves and com-
bustion fronts. In regard to the first problem, two
models are presented which represent the lower and
upper bounds respectively for the gasdynamics solution
of a flow field generated by the initial growth of a flame
kernel in an explosive gas. The second problem is
analyzed by a graphical technique, the vector polar
method. It is concerned only with effects in the large
and can be considered as the generalization of the
method of characteristics to finite wave interaction
processes. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

CALCULATIONS OF SUPERSONIC FLOW PAST
YAWED CONES BY THE METHOD OF THE INTEGRAL
RELATIONS, by M. Holt and S. C. Lee. Mar. 1964
[22]p. incl. diagrs. (Rept. no. AS-64-7) (AF AFOSR-
64-268) AD 603962   Unclassified

The method of integral relations, as applied to the
yawed cone problem by Chushkin and Shchennikov, is
modified to take account of the entropy singularity on
the leeward side of the cone. It is proposed to apply
the method in two regions, in the quadrant adjacent to
the singular generator and in the remaining quadrant
including the cone surface and the shock. Results are
not yet complete but those obtained so far suggest that
the modification will give a more realistic picture of
the flow between the cone and the shock. (Contractor's
abstract)

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California U. Inst. of Engineering Research, Berkeley.

FREQUENCY EFFECTS IN PANEL FLUTTER OF
CYLINDRICAL SHELLS, by R. A. Brown and M. Holt.
Mar. 1964 [21]p. incl. diagrs. refs. (Rept. no. AS-
64-6) (AF AFOSR-64-268) AD 603961 Unclassified

The expression for the pressure coefficient on a
vibrating cylindrical shell of finite length in unsteady
supersonic flow is simplified. The expression is valid
at high values of Mach number and is based on the quasi-
steady approximation when only first order terms in
vibration frequency are considered. The kernel func-
tions arising in the expression for the pressure co-

efficient are tabulated and shown graphically for a
series of circumferential modes. It is anticipated that
the revised expression will be simpler to use than the
earlier expression when introduced into the full panel
flutter equations. (Contractor's abstract)

292

California U. Inst. of Engineering Research, Berkeley.

ANALYTICAL STUDY OF THE CHARACTERISTICS OF
WEDGES IN SUPERSONIC VISCOUS FLOW, by R. T.-S.
Cheng. May 15, 1964 [43]p. incl. diagrs. tables, refs.
(Rept. no. AS-64-6) (Nonr-22245) AD 603319
                                            Unclassified

An analytic study of the normal and axial force
coefficients of wedge-shaped airfoils in supersonic vis-
cous flow is presented. It is based on the inviscid
oblique shock relations to determine the flow conditions
after the oblique shocks in the vicinity of the wedge.
This condition is used as the local free stream condition
which is applied to the available correlation of com-
pressible boundary layer theory on a flat plate at zero
angle of attack. Furthermore, the boundary layer dis-
placement thickness is used as the effective body in the
inviscid supersonic small perturbation theory to predict
local surface pressure. Force coefficients are referred
to the free stream dynamic pressure and the area of the
wedge base. Some numerical calculations were carried
out in order to compare the results with earlier theoreti-
cal and experimental data. (Contractor's abstract)

293

California U. Inst. of Engineering Research, Berkeley.

THE APPLICATION OF LANGMUIR PROBE TECH-
NIQUES TO FLOWING IONIZED GASES, by C. L.
Brundin. June 15, 1964, 116p. (Rept. no. AS-64-9)
(Nonr-22245) AD 603666   Unclassified

A detailed theoretical and experimental investigation
regarding the use of Langmuir probe techniques in a
flowing partially ionized gas was carried out. Both free
molecule and stagnation point probes were considered.
The analysis is restricted to the determination of ion
density from the saturated ion current, and the deter-
mination of electron temperature from the rate of change
of electron current with probe potential. Numerical
results are presented for argon, along with the results
of a series of experiments conducted in an arc heated
supersonic low density wind tunnel. It is concluded that
the ion density can be measured accurately with a stag-
nation point probe, or with a plane free molecule probe
surrounded by a guard ring. The electron temperature
can be measured accurately with a gurarded plane free
molecule probe, or with a cylindrical free molecule
probe aligned with the flow. Measurements made in
flowing gases with other types of Langmuir probes are
subject to certain consistent errors. (Contractor's
abstract)

294

California U. Inst. of Engineering Research, Berkeley.

THE BASE FLOW PROBLEM AT VERY LOW
REYNOLDS NUMBER IN THE OSEEN APPROXIMA-
TION, by H. Viviand and S. A. Berger. Sept. 1964
[42]p. incl. diagrs. (Rept. no. AS-64-15) (Nonr-
22245) AD 608134   Unclassified

The influence of inertia terms in the equations of motion
on the properties of the base flow and near wake flow
at very low Reynolds numbers was investigated by using
Oseen's approximation and by comparing with previous
results obtained by the same authors for Stokes flow.
The general solutions of Oseen's equations of motion
were derived for two-dimensional and axisymmetric
flows in the half-space $x > 0$, for an arbitrarily given
velocity field in the plane $x = 0$. Numerical examples
were given for two-dimensional flow and compared with
Stokes flow examples. (Contractor's abstract)

295

California U. Inst. of Engineering Research, Berkeley.

CYLINDER DRAG IN THE HYPERSONIC FREE JET
OF A RAREFIED AIR STREAM, by S. S.-P. Tang.
Jan. 30, 1964, 41p. (Rept. no. AS-64-3) (Nonr-22245)
AD 431774   Unclassified

Drag forces on circular cylinders normal to axisym-
metric jets issuing from sonic orifices have been
measured. Suitable corrections have been developed
to account for the radial gradients produced by the
source-like flow, thus permitting comparisons of the
present data with data obtained using a uniform flow
field jet. With properties on the axis of the jets as
reference, the data are presented in coefficient form
at Mach numbers of 5.92, 6.30, 8.02, and 9.85. With
Knudsen numbers extending from 1.5 to 30, these data
cover the near free molecule and free molecule flow
regimes. The results indicate a smooth monatomic
transition and agree well at $M = 5.92$ with previous
results obtained in uniform flows. At all Mach numbers,
they agreed with theoretical free molecule flow pre-
dictions for diffuse reflections at the highest Knudsen
numbers attained. Cylinder temperatures were also
measured at the same flow conditions as the drag force
measurements. (Contractor's abstract)

296

California U. Inst. of Engineering Research, Berkeley.

DRAG OF A TWO-DIMENSIONAL STRIP NORMAL TO
HYPERSONIC NEAR FREE MOLECULE FLOW, by
D. R. Ko. Jan. 1964, 73p. (Rept. no. AS-64-4)
(Nonr-22245) AD 431773   Unclassified

Drag coefficients for two-dimensional strips normal
to the flow have been determined experimentally at
Mach numbers of 6.22, 8.12, and 10.09 by means of
the free-jet testing technique. The free stream Knudsen
number ranges from about 1 to 30. Results obtained
are compared to the nearly free-molecule flow theory

proposed by Willis. A number of special tests were
performed to demonstrate the validity of the free-jet
experimental technique and to determine the feasibility
of further application of this valuable testing method.
(Contractor's abstract)

297

California U. Inst. of Engineering Research, Berkeley.

EXPERIMENTAL INVESTIGATION OF LITHIUM-
ARGON SPUTTERING, by V. Malakhof, R. P. Stein,
and H. P. Smith, Jr. Nov. 27, 1963, 47p. (Rept. no.
AS-63-7) (Nonr-22245) AD 431762   Unclassified

The angular distribution of the sputtered lithium atoms
under bombardment by positive argon ions was investi-
gated. Argon ions were created by an arc discharge and
electrostatically accelerated and focused on the target
surface. The object of this investigation was to produce
a sufficient amount of experimental data to substantiate
or modify the already existing theories of angular distri-
bution of the sputtered atoms at the oblique incidence of
a low energy ion beam. The results indicate that at low
ion energies and oblique angles of incidence the angular
distribution is predominantly in the forward hemisphere
relative to incident beam direction, and depends on the
angle of ion incidence. The maximum forward sputter-
ing current occurs at approx 90° to the beam direction.
At low angles of incidence, i.e., below 30° back-
sputtering is possible. There is approx a 40° relation-
ship between the maximum back-sputtering current and
the angle of ion incidence. (Contractor's abstract)

298

California U. Inst. of Engineering Research, Berkeley.

FLOWS OF RAREFIED GASES SUPPORTED BY
DENSITY AND TEMPERATURE GRADIENTS, by C.
Cercignani. Dec. 30, 1964 [21]p. incl. table. (Rept.
no. AS-64-18) (Nonr-22245)   Unclassified

Some features of Poiseuille flow in the transition region
and in the free molecule limit are considered. In par-
ticular it is pointed out that the distribution function in
the main body of the flow is a Burnett distribution func-
tion, with the consequence that second order slip effects
appear. Differences are pointed out between flow sup-
ported by density gradients and flows supported by tem-
perature gradients.

299

California U. Inst. of Engineering Research, Berkeley.

HIGHER ORDER SLIP ACCORDING TO THE
LINEARIZED BOLTZMANN EQUATION, by C.
Cercignani. Dec. 30, 1964 [30]p. incl. refs. (Rept.
no. AS-64-19) (Nonr-22245)   Unclassified

A systematic approach to the problem of the boundary
conditions matching the conservation equations in the
Hilbert or Chapman-Enskog procedures is given. Quan-
titative estimates are also given by using the
Bhatnagar, Gross and Krook model; in particular, the
second order slip coefficient is evaluated. The results

are applied to cylindrical Poiseuille flow and the calculated flow rate is compared with experimental data.

300

California U. Inst. of Engineering Research, Berkeley.

THE MEASUREMENT OF BASE PRESSURE ON WEDGES IN SUPERSONIC LOW DENSITY FLOW, by R. Cheng, S. A. Schaaf, and F. C. Hurlbut. Nov. 30, 1964 [24]p. incl. illus. diagrs. tables, refs. (Rept. no. AS-64-17) (Nonr-22235)   Unclassified

The measurement of the base pressures of wedges is presented. The tests were run at nominal Mach numbers of 4 and 6 and free stream Reynolds numbers from 840 to 8600. A cathetometer was used to measure the height difference of the oil surfaces of a small U-tube manometer mounted within the wind tunnel. Both spanwise and cross-base distributions of the base pressures were measured.

301

California U. Inst. of Engineering Research, Berkeley.

NEARLY-FREE MOLECULAR FLOW: A COMPARISON OF THEORY AND EXPERIMENT, by F. S. Sherman, D. R. Willis, and G. J. Maslach. Oct. 15, 1964 [18]p. incl. diagrs. tables, refs. (Rept. no. AS-64-16) (Nonr-22245)   Unclassified

Presented at Eleventh Internat'l. Cong. for Applied Mechanics, Munich (Germany), Aug. 30-Sept. 5, 1964.

Measured drag coefficients for cylinders, normal strips and spheres in nearly free-molecular flow at $M = 6$, 8 and 10 are correlated with a collision-rate parameter suggested by the modified Krook model, and compared with theoretical estimates based on a variety of kinetic models and methods of analysis. The comparison of theory and experiment and the comparative effectiveness of various rarefaction parameters are discussed, and suggestions for further experimentation are made.

302

California U. [Minerals Research Lab.] Berkeley.

THERMAL PROPERTIES OF ALLOYS AT HIGH TEMPERATURES, by R. L. Orr and R. Hultgren. Final rept. Mar. 1, 1963, 10p. (Series no. 137; issue no. 8) (AFOSR-4614) (AF 49(638)83) AD 407613   Unclassified

The objectives of this investigation were to determine the high temperature thermal properties of various representative alloy systems from heat content measurements, to examine the validity of Kopp's law of additivity of heat capacities of the components, and where possible to correlate the data with various aspects of atomic bonding phenomena in alloys. Heat contents also were measured for a number of pure metals for which existing data were either incomplete or uncertain.

This report reviews briefly the accomplishments of this project, referring where possible to the published papers and technical notes previously submitted.

303

California U. [Minerals Research Lab.] Berkeley.

DILATION CONTRIBUTION TO HEAT CAPACITY OF METALS AND ALLOYS, by Y.-S. A. Chang and R. Hultgren. Jan. 1, 1963 [79]p. incl. diagrs. tables, refs. (Technical note no. 7; series no. 137, issue no. 7) (AFOSR-4616) (AF 49(638)83)   Unclassified

The main objective of this investigation was to study the dilational contribution to heat capacity of copper and alpha-brasses as a function of temperature and composition. Since thermal expansion data were available, it was only necessary to determine the compressibilities. This was done by measuring the velocities of sound in copper and alpha-brasses by means of the ultrasonic pulse technique. A second objective was to test the validity of the Nernst-Lindemann equation, which has been widely used to calculate the dilational term, and the Gruneisen equation. The Nernst-Lindemann equation is recommended over the Gruneisen equation, since the temperature variation of the coefficient of thermal expansion is not required. The error introduced at temperature close to the melting point would be only -13% of the total heat capacity at constant pressure, but as high as 10 - 30% of the total dilational term.

304

California U. [Seismographic Station] Berkeley.

CRUSTAL STRUCTURE SOUTHWEST OF THE SAN ANDREAS FAULT FROM QUARRY BLASTS, by R. M. Hamilton, A. Ryall, and E. Berg. July 9, 1963, 11p. (AF 49(638)904) AD 433750   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 67-77, Feb. 1964.

To determine a crustal model for the southwest side of the San Andreas fault, 6 large quarry blasts near Salinas, Calif., were recorded at 27 siesmographic stations in the region around Salinas, and along a line northwest of the quarry toward San Francisco. Data from these explosions are compared with results of explosion-seismic studies carried out by the U. S. Geological Survey on a profile along the coast of California from San Francisco to Camp Roberts. The velocity of the P wave refracted through the crystalline crust, in the Salinas region is 6.2 km/sec and the velocity of Pn is about 8.0 km/sec. Velocities of the direct P wave in near surface rocks vary from one place to another, and appear to correlate well with gross geologic features. The thickness of the crust in the region southwest of the San Andreas fault from Salinas to San Francisco is about 22 km.

305

California U. [Dept. of Mathematics] Davis.

EXTREMA FOR EIGENVALUES OF VIBRATING SYS-
TEMS, by D. O. Banks. Final rept. [1964] [11]p.
(AFOSR-64-1445) (AF AFOSR-63-82) Unclassified

The results of two areas of research are reported.
The first concerns bounds for the eigenvalues of vibrat-
ing strings. The second concerns bounds for eigenvalues
of a positive symmetric definite matrix A relative to a
non-negative matric B, i.e., the values of λ, such that
the system of equations $(A - \lambda B)x = 0$ has a nontrivial
solution. The results in this case are the analog of
results found earlier by the investigator for the eigen-
values of a vibrating string.

306

California U. [Dept. of Physics] La Jolla.

ASYMPTOTIC FORM OF THE PROPER SELF-ENERGY
FUNCTION IN MANY-PARTICLE SYSTEMS, by D. R.
Fredkin. [1963] [3]p. (AFOSR-J1574) (AF 49(638)1038)
AD 427631   Unclassified

Also published in Jour. Math. Phys., v. 4: 634-636,
May 1963.

The asymptotic form at high frequencies of the
reciprocal of a two-time thermodynamic Green's func-
tion is shown to be a constant. This constant is ex-
pressed as the exact expectation value of a second (func-
tional) derivative of the Hamiltonian. (Contractor's
abstract)

307

California U. [Dept. of Physics] La Jolla.

MANY-BODY THEORY OF LOCALIZED d STATES IN
METALS. I. THE LOCALIZED MOMENT, by H. Suhl
and D. R. Fredkin. [1963] [7]p. incl. diagrs. refs.
(AFOSR-J1579) (AF 49(638)1038) AD 427597
                                             Unclassified

Also published in Phys. Rev., v. 131: 1063-1069,
Aug. 1, 1963.

The problem of the localization of a magnetic moment
around an impurity is formulated in a rotationally in-
variant way, making possible the calculation of the
Curie constant. This calculation is carried out in
lowest order, but, in principle, can be extended to
arbitrary order. (Contractor's abstract)

308

California U. Dept. of Physics, La Jolla.

SUPERCONDUCTIVITY WITH PAIRS IN A RELATIVE
RHO WAVE, by R. Baltan and N. R. Werthamer.
[1963] [12]p. incl. diagr. refs. (AFOSR-64-0754)
(AF 49(638)1038) AD 436507   Unclassified

Also published in Phys. Rev., v. 131: 1553-1564,
Aug. 15, 1963.

In previous treatments of superconducting systems with
attractive interactions acting in odd-angular-momentum
partial waves, the correlated electron pairs were
formed in only two components of a spin triplet. This
oversight is corrected here by a more general varia-
tional treatment, allowing all three components. In the
case of a p-wave interaction, the present state is proved
to give the absolute minimum of the free energy. Its
rotational degeneracy is discussed. The energy spec-
trum is found to be isotropic (provided the normal phase
is also) with the usual gap, and so to be completely
equivalent thermodynamically to the BCS state. The
charge-density autocorrelation is also isotropic, and
the charge-current correlation vanishes. The state ex-
hibits the conventional Meissner effect, and cannot be
experimentally distinguished from the BCS state by
means of electromagnetic or tunneling measurements,
acoustic attenuation, or nuclear magnetic resonance
(NMR) relaxation times. The paramagnetic spin sus-
ceptibility decreases with temperature from its value
in the normal phase to a limiting ratio of 2/3, in good
agreement with results deduced from Knight shift meas-
urements on mercury and tin, and in contrast to the
BCS prediction. (Contractor's abstract)

309

California U. [Dept. of Physics] La Jolla.

MANY-BODY THEORY OF LOCALIZED d STATES IN
METALS. II. FAIR OF IMPURITIES, by P. Gottlieb
and H. Suhl. [1964] [7]p. incl. table. (AFOSR-64-
2528) (AF 49(638)1038) AD 453853   Unclassified

Also published in Phys. Rev., v. 134: 1586-1592,
June 15, 1964.

A previous rotationally invariant perturbation treatment
of localized d states is extended to the case of neighbor-
ing sites interacting via direct d-d exchange and indirect
s-d scattering. It is found that the parallel alignment
of two localized moments is never the ground state of
the pair. For certain values of the unperturbed d-state
energy (depending upon the exchange interactions) only
one of the sites will be occupied by a d electron so the
pair can have a net moment. If the conditions are such
that both sites are occupied by d electrons, these elec-
trons must be aligned antiparallel so there is only a
small net moment due to scattering to and from the band
states. (Contractor's abstract)

310

California U. [Dept. of Physics] La Jolla.

AN INVESTIGATION OF THE PHASE-DIAGRAM
PALLADIUM-ARSENIC IN CONNECTION WITH SUPER-
CONDUCTIVITY, by Ch. J. Raub and G. W. Webb.
[1963] [7]p. incl. diagrs. table, refs. (AFOSR-J829)
(AF AFOSR-62-344) AD 416513   Unclassified

Also published in Jour. Less-Common Metals, v. 5:
271-277, 1963.

The phase-diagram Pd-As has been investigated by thermal, röntgenographic and metallographic analysis, together with superconductivity measurements. The existence of five phases, three of them previously unknown, has been established. Addition of arsenic to palladium causes a sharp drop of the liquidus curve. At 770°C the compound Pd_7As is formed peritectically. Increasing the amounts of As causes the eutectic at 20 at-% As (715°C) to be followed by a peritectic reaction (820°C) between liquid and the congruently melting compound Pd_5As_2 (860°C), forming Pd_3As. At 33 at-% As the peritectically formed phase Pd_2As (728°C), which transforms at 485°C into a low temperature modification exists. The homogeneity range of $PdAs_2$ was found not to be as broad as claimed earlier. Three of the compounds are superconductors: Pd_5As_2 (T_c = 0.46°K), Pd_2As h.t. (T_c = 1.71°K) and Pd_2As l.t. (T_c = 0.60°K).

311

California U. [Dept. of Physics] La Jolla.

DENSITIES OF STATES, SUPERCONDUCTIVITY, AND LOCALIZED MOMENTS IN TRANSITION METALS, by B. R. Coles. [1963] [4]p. (AFOSR-J1134) (AF AFOSR-62-344) AD 421722   Unclassified

Also published in Solid State Comm., v. 1: 5-8, 1963.

Correlations between density of states at the Fermi surface, superconductive transition temperature and the tendency of solute iron atoms to carry localized moments are examined for second and third transition group metals; the breakdown of expected correlations is ascribed to the change in character of the d-band wave functions. (Contractor's abstract)

312

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY IN THE MERCURY-INDIUM ALLOY SYSTEM, by M. F. Merriam, M. A. Jensen, and B. R. Coles. [1963] [8]p. incl. diagrs. table, refs. (AFOSR-J1135) (AF AFOSR-62-344) AD 421151
                                    Unclassified

Also published in Phys. Rev., v. 130: 1719-1726, June 1, 1963.

The superconducting transition temperatures of a large number of Hg-In alloys have been measured and the variation of T_c with composition determined over the entire range. Variation of T_c with number of valence electrons/atom within any particular metallurgical phase is quite strong, T_c in general increasing with decreasing number of valence electrons. The maximum and minimum values of T_c occurring in the system are 4.5 and 3.1°K at approx 80 and 20 at-% indium, respectively. HgIn, the only stoichiometric compound, has a transition temperature of 3.81°K. The observed composition dependence of T_c is not what one would expect either from Matthias's empirical rules or from the simple BCS formula, assuming a nearly free electron model for the density of states. In one phase a

discontinuity in T_c and its composition dependence is found which cannot be correlated with a change in any lattice property and apparently arises from a discontinuous change in electronic structure.

313

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY OF SOME NEW Pt-METAL COMPOUNDS, by Ch. J. Raub, W. H. Zachariasen and others. [1963] [8]p. incl. diagrs. tables, refs. (AFOSR-64-0250) (AF AFOSR-62-344) AD 432746
                                    Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 1093-1100, 1963.

Several new superconductors were discovered among compounds between Pt-metals and elements of the IV A, V A and VI A group of the periodic system. The position of the elements in the periodic system, the valence electron concentration and the crystallographic structure exhibit a strong influence on the superconducting behavior.

314

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY IN THE INDIUM-TIN SYSTEM, by M. F. Merriam and M. von Herzen. [1963] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-64-0459) (AF AFOSR-62-344) AD 435661   Unclassified

Also published in Phys. Rev., v. 131: 637-643, July 15, 1963.

Transition temperatures as a function of composition have been measured throughout the In-Sn binary system. Samples 'quenched' from the liquid state had higher transition temperatures than well-annealed samples, confirming the effect reported earlier for Hg-In compositions. The enhancement in T_c was 2-3°K for the most favorable compositions. It is argued that the effect arises from internal strains in the samples and not from short-range disorder. The equilibrium T_c values vary from 3.4°K (near pure In) to 6.6°K (β phase, 33.5 at-% Sn). Transition temperature within any particular phase is a strong function of valence electron concentration, but not a function of the type found in transition metal superconductors. In all phases T_c increases with increasing valence electron concentration. The data in the In terminal solid solution are compared with the BCS formula, and with the theory of Morel and Anderson. A substantial variation of the electron-phonon interaction parameter with alloying is required if the data are to be described with the BCS formula.

315

California U. [Dept. of Physics] La Jolla.

BRILLOUIN ZONE EFFECTS, SUPERCONDUCTIVITY,

AND FERMI SURFACE OF INDIUM ALLOYS, by M.
F. Merriam. [1963] [3]p. incl. diagrs. refs. (AFOSR-
64-0460) (AF AFOSR-62-344) AD 435904
Unclassified

Also published in Phys. Rev. Ltrs., v. 11: 321-323,
Oct. 1, 1963.

A description is given of a Fermi surface-Brillouin
zone interaction in the indium-rich solid solution of
the In-Sn and In-Pb systems which is reflected in both
lattice parameter and superconducting properties.
Since the structure of indium is tolerably simple, and
since a good deal is already known experimentally about
the Fermi surface in pure indium, a reasonable guess
as to the specific nature of the electronic effect can be
made. The lattice parameter data also lead, in this
case, to a reinterpretation of the existing magneto-
acoustic data on the Fermi surface of In.

316

California U. [Dept. of Physics] La Jolla.

SIMPLE MODEL FOR THE SUPERCONDUCTIVITY
OF LANTHANUM AND URANIUM, by G. C. Kuper,
M. A. Jensen, and D. C. Hamilton. 1963, 7p.
(AFOSR-64-1213) (AF AFOSR-62-344) AD 443019
Unclassified

Also published in Phys. Rev., v. 134: A15-A21,
Apr. 6, 1964.

It is postulated that La and U have a narrow f band
above, but very close to, the Fermi surface. An ex-
change interaction, antiferromagnetic in sign, between
electrons in the f band can lead to nonzero occupation
of the f levels in a BCS-type wave function. This f-
band condensation, through a weak coupling of the f
band to the conduction band, enhances a BCS condensa-
tion of the conduction electrons. There are two energy
gaps, for quasiparticle excitations in the two bands.
The critical field at zero temperature is calculated, as
in the transition temperature. The predicted isotope
effect is extremely small. The ratio between the
transition temperature and the energy gap at T = 0
depends on the numerical values of the parameters;
although this ratio is of the order unity, it would not
be expected to be too near the BCS value of 1/1.75.
(Contractor's abstract)

317

California U. [Dept. of Physics] La Jolla.

[ON THE SUPERCONDUCTIVITY OF TERNARY BETA
TITANIUM ALLOYS] Uber die Supraleitfahigkeit
ternarer Beta-Titanlegierungen, by Ch. J. Raub.
[1963] [5]p. (AFOSR-64-1233) (AF AFOSR-62-344)
AD 442805 Unclassified

Also published in Zeitschr. Phys., v. 178: 216-220,
1964.

The elements Sc to Cu, Y to Ag, and La to Au were
alloyed in a beta-Ti-Rh system. The superconducting

behavior of this ternary mixed crystal was investigated.
The transition temperature-concentration curves are
strikingly similar for all the elements with 3d, 4d, and
5d electrons, and can be explained on the basis of
Matthiasschen's law by the change of the valence elec-
tron concentration, the transition temperature of the
alloys increases, fluctuates between N = 4.4 and 4.6
reaches a maximum at about 4°K, then decreases.
Manganese and rhenium, as well as the ruthenium and
osmium alloys deviate from the steady fluctuations of
the transition temperature curves. This can be ex-
plained by the magnetic characteristics of the elements
concerned.

318

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY OF SOLID SOLUTIONS OF Ti
AND Zr WITH Co, Rh, AND Ir, by Ch. J. Raub and
G. W. Hull, Jr. [1963] [3]p. (AFOSR-64-1234)
(AF AFOSR-62-344) AD 442808 Unclassified

Also published in Phys. Rev., v. 133: A923-A934,
Feb. 17, 1964.

A detailed investigation of superconductivity in alpha
and beta Ti and Zr solid solutions with Co, Rh, and Ir
showed that T alpha rises with increasing valence elec-
tron concentration n. Small amounts of Co, Rh, and Ir
dissolved in alpha Ti, or alpha-Zr increase Tc by a
factor of 2 to 4. In the bcc phase region of the beta-
Ti alloys Tc goes through a maximum of 4°K at 90 at-%
Ti, which is explained by Matthias' rule. (Contractor's
abstract)

319

California U. [Dept. of Physics] La Jolla.

BEAM STABILITY IN THE ELECTRON PROBE MICRO-
ANALYZER, by R. Fitzgerald. [1964] [12]p. (AFOSR-
64-2112) (AF AFOSR-62-344) AD 451354
Unclassified

Also published in Proc. Twelfth annual Conf. on
Applications of X-ray Analysis, Denver, Colo., Aug. 7-
9, 1963, v. 7: 369-381, 1964.

The reliability and speed at which an analysis can be
completed, using methods of the electron probe micro-
analyzer, depends to a large extent on the stability of
the electron beam. The incident electron energy and
total incident current must be maintained within pre-
scribed limits to ensure accurate and reproducible
x-ray data. The incident electron probe diameter must
also stay within prescribed limits for maximum resolu-
tion over the analysis time. The performance of the
electron optics is discussed in relation to high-voltage
supply, current regulators and filament supply. Methods
for probe current stabilization using aperture sensing
are discussed. (Contractor's abstract)

320

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY OF TELLURIUM, by B. T. Matthias and J. L. Olsen. [1964] [2]p. incl. diagr. (AFOSR-65-0805) (AF AFOSR-63-344) AD 617199
Unclassified

Also published in Phys. Ltrs., v. 13: 202-203, Dec. 1, 1964.

A superconducting transition in tellurium under high pressure at approx 3.3°K was observed. This is the first superconductivity noted in the 6th column of the periodic table. This observation supports the view that superconductivity is a general phenomenon.

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California U. Dept. of Physics [La Jolla].

A NEW C15$_b$-TYPE PHASE—CaAu$_5$, by Ch. J. Raub and D. C. Hamilton. [1964] [3]p. incl. table, refs. (AFOSR-65-0806) (AF AFOSR-62-344) AD 617198
Unclassified

Also published in Jour. Less-Common Metals, v. 6: 486-488, 1964.

X-ray, x-ray fluorescence, and superconductivity meas‑ urements were made of the gold-rich Ca-Au system at Au concentrations between 80 and 90 at-%. The metals were pressed together into a small pellet, put in an alumina crucible inside an evacuated quartz-tube and heated up to approx 1000°C. The good agreement be‑ tween observed and calculated intensities confirmed the assumption of a C15$_b$ type of structure for this phase. In order to establish the concentration of the C15$_b$ phase the alloy CaAu$_5$ was examined by x-ray fluorescence microprobe. Besides a little free gold, the sample showed only a phase with 83 at-% Au, cor‑ responding to CaAu$_5$. Samples with 80 at-% Au were only partially superconducting, even though the x-ray pattern was not different from the CaAu$_5$ pattern. It was concluded that the composition of the Ca-Au phase that is richest in gold is CaAu$_5$ and not CaAu$_4$ as given by the phase diagram.

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California U. Dept. of Physics, La Jolla.

PEIERLS PROOF OF SPONTANEOUS MAGNETIZA‑ TION IN A TWO-DIMENSIONAL ISING FERROMAGNET, by R. B. Griffiths. [1964] [3]p. incl. diagr. refs. (AFOSR-65-0189) (AF AFOSR-64-610) AD 456567
Unclassified

Also published in Phys. Rev., v. 136: A437-A439, Oct. 19, 1964.

A few minor modifications are made in the Peierls argu‑ ment that a two-dimensional Ising ferromagnet possesses a spontaneous moment at sufficiently low temperatures, in order to make the proof quite rigorous.

323

California U. [Dept. of Physics] La Jolla.

[SUPERCONDUCTIVITY OF THE NOBLE METALS AND THEIR ALLOYS] Supraleitfähigkeit der Edelmetalle und ihrer Legierungen), by Ch. [J.] Raub. [1964] [5]p. (AFOSR-64-1217) (AF AFOSR-64-631) AD 443023
Unclassified

Also published in Zeitschr. Metalik, v. 55: 195-199, 1964.

Only three of the noble metals are superconductors above 0.35°K, but it is very likely that gold and platinum of highest purity become superconductors at lowest temperatures (10^{-3}K). None of the solid solutions of gold or silver, but several solid solutions of the platinum metals, are superconduction. Small additions of noble metals to superconducting elements of group V reduce their transition-temperature, in group V they increase T_c. Only a few superconducting silver- or gold- com‑ pounds are known. A survey of the superconducting compounds of the platinum metals with the transition and nontransition elements shows some general features: the highest transition temperatures occur among the beta-tungsten, A12 and delta-phases and with increasing metallic properties of the groups IV A, V A and VI A of the periodic system the concentration of the super‑ conducting phases shifts to smaller platinum metal con‑ centrations. (Contractor's abstract)

324

[California U. Dept. of Physics, La Jolla]

SUPERCONDUCTING METASTABLE COMPOUNDS, by H. L. Luo, M. F. Merriam, and D. C. Hamilton. [1964] [2]p. incl. diagr. table, refs. (AFOSR-64-2117) (AF AFOSR-64-631) AD 451704
Unclassified

Also published in Science, v. 145: 581-583, Aug. 7, 1964.

A number of metastable phases, germanides and tellu‑ rides of gold and silver, has been prepared, analyzed by x-ray diffraction, and investigated for superconduc‑ tivity. The new superconductors and their transition temperatures are AgTe$_3$ (2.6°K), Ag$_4$Ge (0.85°K), Au$_3$Te$_5$ (1.62°K), and Au$_{1-x}$Ge$_x$ (0.99°K — 1.63°K) where ($0.27 \leq x \leq 0.60$). Au-Ge compositions with other value of x do not superconduct above 0.32°K. (Contractor's abstract)

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California U. [Dept. of Physics] La Jolla.

EFFECT OF DISSOLVED MANGANESE ON SUPER‑ CONDUCTIVITY OF PURE AND IMPURE INDIUM, by M. F. Merriam, S. H. Liu, and D. P. Seraphim. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-0191) (AF AFOSR-64-631) AD 456594
Unclassified

Also published in Phys. Rev., v. 136: A17-A21, Oct. 5, 1964.

The superconducting critical temperature of In decreases by ~70°K per unit resistance ratio, $\rho 4.2/\rho 273°K$, when doped with Mn. The addition of a third element, Pb or Sn (just a few %), progressively decreases the effect of the Mn and eliminates the effect completely when the mean free path is decreased to ~500A. The data are explained on the basis of the Korringa model for the resistivity-minimum phenomenon found in dilute transition-metal solutions. It is assumed that the scattering of the conduction electrons undergoes a resonance (presumably caused by the localized moments) of width ~1°K at the Fermi surface. The effect disappears when enough nonparamagnetic impurity is added to make the width of the electron energy levels large compared to that of the resonance. The technique and the model (if correct) opens a new way for investigating the resonance model for paramagnetic impurities.

326

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY OF SODIUM TUNGSTEN BRONZES, by Ch. J. Raub, A. R. Sweedler and others. [1964] [2]p. incl. diagr. (AFOSR-65-0791) (AF AFOSR-64-631) AD 616055   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 746-747, Dec. 21, 1964.

The superconductivity was determined for sodium tungsten bronzes having a general formula Na_xWO_3 with $0.1 < x \lesssim 1$. The transition temperatures are in the range below 1°K.

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California U. Dept. of Physics, La Jolla.

[ON THE CRYSTAL STRUCTURE OF THE GOLD-RICH PHASES IN THE SYSTEM GALLIUM-GOLD AND RUBIDIUM-GOLD] Uber die Kristallstrukturen der goldreichsten Phasen in den Systemen Kalium-Gold und Rubidium-Gold, by Ch. J. Raub and V. B. Compton. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0792) (AF AFOSR-64-631) AD 616053 Unclassified

Also published in Zeitschr. Anorg. Allgem. Chem., v. 332: 5-11, June 1964.

The crystal structure of the compounds KAu_5 and $RbAu_5$ were determined. Both compounds have the hexagonal $CaCu_5$ type structure, space group $D^1 - P^6/mmm$ with one formula weight in the unit cell. The lattice constants 6h for KAu_5 are a = 5.659A, c = 4.483A and for $RbAu_5$ a = 5.760A, c = 4.448A. Contrary to former statements the formulae of these compounds are KAu_5 and $RbAu_5$ and not KAu_4 and $RbAu_4$.

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California U. [Dept. of Physics] La Jolla.

EFFECT OF UNIAXIAL STRESSES ON THE PARAMAG-

NETIC SPECTRA OF Mn^{3+} AND Fe^{3+} IN MgO, by E. R. Feher. [1964] [13]p. incl. diagrs. table, refs. (AFOSR-65-0793) (AF AFOSR-64-631) AD 616052
Unclassified

Also published in Phys. Rev., v. 136: A145-A157, Oct. 5, 1964.

The study investigates the lowest energy levels of the paramagnetic ions Mn^{2+} and Fe^{3+} in the host crystal MgO as a function of externally applied uniaxial stress. The effect of the stress on the energy levels of the paramagnetic ion can be described by introducing into the spin Hamiltonian an additional term of the form S·D·S. When the components of D are expressed as linear functions of the applied stress components, there are only 2 independent constants of proportionality in the simple case of a cubic crystalline lattice. In this note these constants have been experimentally determined. Also investigated are the absolute value and the angular dependence of the linewidth of the fine structure of Mn^{2+} and Fe^{3+} in MgO. The widths are accounted for in terms of the spin-lattice coefficients by assuming a random distribution of internal stresses in the host sample. Also treated is the relevance of the spin-lattice coefficients in the determination of the direct spin-lattice relaxation times.

329

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTING TUBES AND FILAMENTS, by G. Arrhenius, R. Fitzgerald and others. [1964] [4]p. incl. illus. diagr. (AFOSR-65-0794) (AF AFOSR-64-631) AD 615683   Unclassified

Also published in Jour. Appl. Phys., v. 35: 3487-3490, Dec. 1964.

A study is reported of the superconductivity and microstructure which occur when small quantities of La are quenched with Rh in the arc furnace. A strikingly regular prismatic honeycomb of a superconducting compound is found when the La concentration is ≥ 0.5 at-%. For smaller concentrations a continuous network of the superconducting phase is no longer observed which correlates with the lowering and broadening of the superconducting transition region. Evidence is given that for such low concentrations superconducting tunneling occurs through the elemental Rh phase itself thus pointing to the superconductivity of Rh at lower temperatures.

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California U. Dept. of Physics, La Jolla.

[SUPERCONDUCTIVITY AND PHASE TRANSFORMATION IN TITANIUM ALLOYS. I. ADDITION OF VANADIUM PLUS ALUMINUM, NIOBIUM AND MOLYBDENUM] Supraleitung und Phasenumwandlung bei Titanlegierungen. I. Zusätze von Vanadium + Aluminum, Niob und Molybdän, by Ch. J. Raub and U. Zwicker. [1964] [5]p. incl. illus. diagrs. refs. (AFOSR-65-2546) (AF AFOSR-64-631) AD 629830   Unclassified

Also published in Zeitschr. Metallkunde, v. 55: 711-715, 1964.

The change of transition temperature during the β/α-transformation of the alloys $TiV_{16}Al_3$, $TiMo_{16}$ and $TiNb_{33}$ was investigated. The transition temperature is influenced by the concentration of the alloying elements in the β-matrix and hence by the valence electron concentration. The influence of the ordered intermediate phases is small. The transition temperature of the α-solid solution can be increased by Va-group elements, but in the alloys investigated the transition temperature of β-phase is nigher than that of the α-phase and therefore the value for T_c corresponds to that of the β-phase. The concentration of alloying elements in the β-phase and thus the transition temperature can be shifted to higher or lower values by normal or up-hill diffusion during the transformation processes. (Contractor's abstract)

331

California U. Inst. of Geophysics and Planetary Physics, La Jolla.

COMPARATIVE SEISMIC NOISE ON THE OCEAN BOTTOM AND ON LAND, by H. Bradner and J. G. Dodds. [1964] [10]p. incl. illus. diagrs. tables, refs. (AFOSR-65-2897) (AF AFOSR-62-420) AD 452688
Unclassified

Also published in Jour. Geophys. Research, v. 69: 4339-4348, Oct. 15, 1964.

Recordings of the seismic noise background have been made on the Pacific Ocean bottom at a depth of 5 km with internally recording single-component seismometers which are recovered after automatic release of ballast. Simultaneous recordings have been made at land stations. High-resolution noise spectra in the frequency band between 0.12 and 9 cps have been obtained by digital analysis. Comparison of amplitudes or phase shifts does not indicate coherence between two distant records, and relative energy distribution between orthogonal components of a three-component seismometer record does not indicate significant Rayleigh wave energy. The ocean-bottom noise spectrum has a shape qualitatively similar to the continental land noise spectrum, but greater in magnitude. The Hawaiian Island spectra show the usual 6- to 8-sec microseism peak. but less high-frequency structure than the continental United States spectra. (Contractor's abstract)

332

California U. Brain Research Inst., Los Angeles.

SPECTRAL ANALYSIS OF ELECTROENCEPHALO-GRAMS RECORDED DURING LEARNING IN THE CAT, BEFORE AND AFTER SUBTHALAMIC LESIONS, by D. O. Walter and W. R. Adey. [1963] [22]p. incl. diagrs. diagrs. tables, refs. (AFOSR-5347) (AF AFOSR-61-81) AD 421725
Unclassified

Also published in Exper. Neurol., v. 7: 481-501, 1963.

The remarkable slow waves found in EEG of the dorsal hippocampus and related structures during acquisition of a conditioned discriminatory reflex are studied by spectral analysis. Some of the analysis is given in detail as a tutorial illustration of spectral analysis. Visual observations of the frequency specificity of those waves, and the detailed mirroring of these wave processes between hippocampus and entorhinal cortex, are numerically confirmed. The slowing and irregularization of these waves produced by serial bilateral lesions in the far-off subthalamic areas is quantified, and shown to differ in evolution between the hippocampus and entorhinal areas. The spectral results show a persistent disparity in the frequency peaks of the two rhinencephalic traces, which requires the assumption of a nonlinear relationship between these areas, superadded to the linear one. The relation between hippocampal waves and those in the reticular formation of the mesencephalon and in the visual area of the lateral neocortex is also shown to be a distinctly nonlinear one.

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California U. Brain Research Inst., Los Angeles.

SLEEP: CORTICAL AND SUBCORTICAL RECORDINGS IN THE CHIMPANZEE, by W. R. Adey, R. T. Kado, and J. M. Rhodes. [1963] [2]p. incl diagr. (AFOSR-53 5364) (AF AFOSR-61-81) AD 423044 Unclassified

Also published in Science, v. 141: 932-933, Sept. 6, 1963.

Electroencephalographic sleep patterns of chimpanzees reveal greater similarities to human records than those of lower mammals. Flash-evoked responses in the mid-brain reticular formation remain during "paradoxical" sleep, which does not appear to necessarily involve deep unconsciousness. Characteristic spindling occurs in the amygdala during a "paradoxical" type sleep while other areas were desynchronized. Telencephalic sleep-control mechanisms in higher primates are considered.

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California U. Brain Research Inst., Los Angeles.

SPECTRAL ANALYSIS FOR ELECTROENCEPHALO-GRAMS: MATHEMATICAL DETERMINATION OF NEUROPHYSIOLOGICAL RELATIONSHIPS FROM RECORDS OF LIMITED DURATION, by D. O. Walter. [1963] [27]p. incl. diagrs. refs. (AFOSR-5365) (AF AFOSR-61-81) AD 423045 Unclassified

Also published in Exper. Neurol., v. 8: 155-181, 1963.

Spectral analysis is a mathematical method which contains and generalizes frequency analysis. The form of spectra analysis most applicable to EEG is presented, using both algebraic formulae and 4 simplified illustrative examples. The coherence function and transfer function are the analogs of correlation coefficient and regression coefficient. The coherence function is applied not only to calculate the "quantity of

interdependence" between pairs of illustrative examples, but also to supply probable bounds on the other calculated relationships. Finally, discussion of the assumptions underlying spectral analysis prepares the methods for application to actual EEG.

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California U. [Brain Research Inst.] Los Angeles.

THE INTERACTION OF PLANT HORMONES AND ROTATION AROUND A HORIZONTAL AXIS ON THE GROWTH AND FLOWERING OF XANTHIUM PENSYLVANICUM, by T. Hoshizaki, B. H. Carpenter, and K. C. Hamner. [1964] [9]p. (AFOSR-64-1082) (AF AFOSR-61-81) AD 441469   Unclassified

Also published in Planta, v. 61: 178-186, 1964.

Xanthium pensylvanicum plants were rotated around a horizontal axis at 0.25 rpm. The stem growth, and flowering response were studied in rotated Xanthium treated with gibberellic acid (GA3), indoleacetic acid (IAA). Leaf growth of rotated Xanthium was also studied. In both light and dark, the length and the number of nodes in stems of rotated Xanthium were significantly less than the stationary controls. Application of 10 μg and 100 μg of GA3 increased the stem length over that of the untreated controls and furthermore, GA3 application decreased the dwarfing effect of rotation such that stems of rotated Xanthium treated with GA3 were not significantly different from stationary GA3 treated plants. In rotated Xanthium plants, floral enhancement did not occur when GA3 was applied just prior to rotational treatment. Foliar application of IAA to both rotated and stationary plants did not significantly affect the floral response.

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California U. [Brain Research Inst.] Los Angeles.

STUDIES OF BRAIN FUNCTION AND BEHAVIOR, by J. D. French, W. R. Adey, and H. W. Magoun. Final rept. May 1, 1961-Apr. 30, 1963. May 25, 1964, 10p. (AFOSR-64-1195) (AF AFOSR-61-81) AD 442844
                                            Unclassified

This study includes single brain cells and their discharge patterns during Pavlovian conditioning ic development and evaluation of brain wave recording techniques in pilots flying high performance aircraft on pursuit missions. Much of the work has involved development of new techniques for computational analysis of electroencephalographic and other neurophysiological data. In turn, these techniques have led to the formulation of a series of realistic models of the processes of transaction and storage of information in brain tissue. These models are now being assessed in actual physiological experiments. In addition to purely neurophysiological studies, investigations have been made of the effects of isolation and confinement in simulated orbital flights on urinary steroid excretion in the monkey. These studies have been coupled with evaluation of increased gravitational loads, whole body irradiation and decompression on renal functions, including calcium

excretion. Other studies have tested interaction of altered gravitational fields and hormones on normal plant maturation, and the effects of continuous high intensity light on circadian plant rhythms. (Contractor's abstract)

337

California U. [Brain Research Inst.] Los Angeles.

A LARGE SIZE ECONOMICAL PLANT GROWTH CHAMBER, by T. Hoshizaki, J. Zweizig, and P. Broberg. [1963] [5]p. incl. diagrs. (AFOSR-65-0937) (AF AFOSR-61-81) AD 622912   Unclassified

Also published in Proc. Amer. Soc. Horticultural Sci., v. 83: 844-848, 1963.

A design is presented for a low-cost plant growth chamber with an adequately controlled environment. The chamber is constructed of wood and requires a minimum of skilled labor. Its total cost is approx $1900. Its dimensions on the inside are 4 x 6 x 8 ft. The refrigeration is provided by a 1 hp unit, and glass wool battings are used for insulation. The temperature is maintained within 1/2°F of the desired temperature by a pulse-cooling system. The light control system varies the intensity by turning selected lamps on or off in 4 steps, from complete darkness to 1500 ft-c at a level 28 in. below the lamp.

338

California U. [Brain Research Inst.] Los Angeles.

THE INFLUENCE OF SIMULATED ALTITUDE (18,000 feet) ON UROFLOWMETRY, by A. T. K. Cockett and E. Bors. [1964] [5]p. incl. diagrs. table. (AFOSR-65-1777) (AF AFOSR-61-81) AD 626489
                                            Unclassified

Also published in Urol. Internat'l., v. 18: 357-361, 1964.

A study to determine the effect of high altitudes on the voiding rates of several subjects is reported. The experiment was carried out in an altitude simulator with barometric pressure equal to an altitude of 18,000 ft. Sixteen subjects were tested using an automatic uroflowmeter. It is concluded that high altitude has no effect on urine flow.

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California U. [Brain Research Inst.] Los Angeles.

NEWER CONCEPTS IN THE PATHOPHYSIOLOGY OF EXPERIMENTAL DYSBARISM-DECOMPRESSION SICKNESS, by A. T. K. Cockett and R. M. Nakamura. [1964] [5]p. incl. illus. diagrs. table. (AFOSR-66-1942) (AF AFOSR-61-81) AD 643044   Unclassified

Presented at annual meeting, Amer. Coll. Surgeons. Santa Barbara, Calif., Jan. 17-19, 1964.

Also published tn Amer. Surgeon, v. 30: 447-451, July 1964.

Hemoconcentration has been observed tn a significant number of patients who develop dysbarism. In every tnstance a greater than 2:1 barometrtc pressure change had occurred. The present study was formulated (1) to evaluate the apparent loss of plasma volume by subject- ing animals to a 5:1 barometrtc pressure change; and (2) to determtne the pathological changes tn antmals undergoing the pressures whtch represent an LD 100 model.

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California U. Brain Research Inet., Los Angeles.

COMPARISON OF THE AVERAGE CORTICAL AND SUBCORTICAL EVOKED RESPONSE TO CLICKS DURING VARIOUS STAGES OF WAKEFULNESS, SLOW WAVE SLEEP AND RHOMBENCEPHALIC SLEEP, by W. D. Winters. [1964] [12]p. tncl. diagrs. table, refs. (AF AFOSR-61-81)   Unclasstfted

Publtshed in Electroenceph. Clin. Neurophystol., v. 17: 234-245, 1964.

The purpose of thts paper wau to examtne the relation- shtp of background EEG and evoked response to cltcks wtth changes tn wakefulness-sleep cycles in cats with chrontcally tmplanted electrodes. Several points are apparent: (1) Shape and amplttude of evoked responses tn the anterior suprasylvian gyrus (ASG) changed tn a predictable manner durtng the vartous states of wake- fulness and sleep. (2) The evoked response in ASG is similar durtng rhombencephalic phase of sleep (RPS) distraction and wakefulness, whereas that tn the rec- ticular formation (MBRF) ts reduced or absent during RPS and distraction but present during wakefulness. This suggests that the long latency ASG response does not require the tntegrtty of the MBRF. (3) The evoked response and background EEG are stmilar dui ing both RPS and alert distraction tn the ASG, thalamus, caudate and MBRF. Thts suggests that the RPS is a state stmilar to distraction, rather than a deep stage of sleep.

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Caltfornia U. [Bratn Research Inst.] Los Angeles.

THE EFFECT OF WHOLE BODY IRRADIATION (300r) ON EXPERIMENTAL BLADDER CALCULUS FORMA- TION IN RATS, by A. T. K. Cockett, R. M. Nakamura and others. [1964] [3]p. tncl. tables. (AF AFOSR-61- 81)   Unclasstfted

Published tn Invest. Urol., v. 1: 552-554, May 1964.

A method for the whole body irradiation of rats with bladders containing magnestum discs ts described. Whole body irradiation (300r) stgniftcantly reduced the stze of experimentally formed bladder calculi tn rats. Plasma phosphorus values were stgnificantly htgher tn the disc-nonirradiated group.

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California U. Bratn Research Inst., Los Angeles.

EFFECTS OF GRAVITY ON THE FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM, by W. R. Adey. [1964] [21]p. tncl. illus. diagrs. refs. (AF AFOSR- 61-81)   Unclasstfted

Publtshed in Life Sctences and Space Research II, Fourth Internat'l. Space Science Sym?ostum (Warsaw, Poland) (June 3-12, 1963), Amsterdam, North-Holland Publtshtng Co., 1964, p. 267-286.

The senstttvity of the mammalian central nervous sys- tem to gravitational influences tnvolves both direct and indirect factors. Gradual loss of cerebral circulation with tncreastng acceleration beyond 5 G has been shown to evoke changes in patterns of bratn electrtcal activity, with epileptiform discharges trtggered primarily in the hippocampal system of the temporal lobe, and spreading into other brain systems. The relationshtp of these structures to judgment and discrtmtnattve functions ts discussed. Tests of vibrational stimult tn the monkey have disclosed "driving" of electrtcal bratn rhythms at the shaking freqvency, particularly tn the range from 11 to 15 cycles per second. These effects are unrelated to photic stimulation, and are abolished by anesthesia or death. Tests of discrimtnative capabiltty at fre- quencies productng maximum drtving have shown in- creased response latencies and increased errors. The neurophystological basis for adaptive phenomena tn re- current vestibular stimulation has been found to restde partly in the vestibular nuclei of the medulla, and not to require tntegrtty of connections with higher vestibular centers.

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California U. [Brain Research Inst.] Los Angeles.

THE EFFECTS OF REGIONAL HYPOTHERMIA ON THE CANINE URINARY BLADDER, by A. T. K. Cockett and R. M. Nakamura. [1964] [8]p. incl. tllus. diagrs. table. (AF AFOSR-61-81)   Unclasstfted

Publtshed tn Invest. Urol., v. 2: 14-21, July 1964.

Hypothermia to the cantne urtnary bladder will produce charactertstic htstologic changes in the epithelium and submucosa. A modified catheter for regional hypo- thermia ts described, and temperatures employed for cooltng are listed. (Contractor's abstract)

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[California U. Bratn Research Inst., Los Angeles]

[THE PROCESSING AND STORAGE OF INFORMATION IN THE NERVOUS SYSTEM. A MODEL SUGGESTED BY THE STUDY OF HIPPOCAMPAL MECHANISMS IN THE COURSE OF TRAINING] L'Élaboration et le stockage de l'informatton dans le système nerveux. Un modele suggéré par l'étude des mécanismes

hippocampiques au cours de l'apprentissage, by W. R. Adey. [1963] [33]p. incl. diagrs. refs. (AF AFOSR-61-81)   Unclassified

Published in Actualités Neurophysiol., v. 5: 263-295, 1963.

This paper presents results on the functioning of the hippocampus during the acquisition of a discriminative behavior of the cat. Results have shown the possible role of the EEG slow waves in information transmission within the cerebral systems, and the possibility that the neuron itself serves as a phase comparator of intrinsic and extrinsic slow waves which pass over the neuronal membrane in very complex spatio-temporal patterns. A method has been developed to measure, by implanted electrodes, the electrical impedance of a small volume of hippocampal tissue. Transitory but significant impedance changes occurred only during training of discriminative behavior, and they began to appear only when the trained behavior became superior to that expected by chance. The impedance changes have been interpreted as related to ionic movements, possibly in the glial tissues; the latter may function as a variable and probably nonlinear resistance for the electronic processes of the neuronal dendritic trees, which are most likely responsible for the electrical waves seen in cerebral tissues.

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California U. [Brain Research Inst.] Los Angeles.

REDUCTION IN RENAL VEIN OXYGEN SATURATION AND OXYGEN TENSION IN EXPERIMENTAL UNILATERAL RENAL ARTERY STENOSIS, by A. T. K. Cockett, C. K. Liu and others. [1964] [7]p. incl. diagrs. table, refs. (AF AFOSR-61-81)
                                        Unclassified

Presented at Soc. Univ. Surgeons Annual meeting, Los Angeles, Calif., Feb. 13, 1964.

Published in Invest. Urol., v. 2: 71-77, July 1964.

This study reveals that two parameters—oxygen saturation and oxygen tension—are significantly reduced in venous blood from the ischemic kidney. On the basis of these findings a more comprehensive study, including the correlation of specific decrements in renal blood flow with the parameters used in the present study, will be undertaken. A study of the difference between renal veins of these parameters in hypertensive patients is warranted and may be of use in differentiating the patient with clinically significant unilateral renal artery stenosis from other types of hypertension.

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California U. [Brain Research Inst.] Los Angeles.

RENAL DESCENT DURING VALSALVA MANEUVER IN SUPINE AORTOGRAPHY: SIMPLE MEANS TO IMPROVE DETAIL AND DEMONSTRATE EFFECT OF NEPHROPTOSIS OF THE RENAL ARTERY, by B. I.

Rein and A. T. K. Cockett. [1964] [4]p. incl. illus. refs. (AF AFOSR-61-81)   Unclassified

Published in Jour. Urol., v. 92: 217-220, Sept. 1964.

Performance of the Valsalva maneuver during aortography in the supine position is suggested as a simple convenient means to cause downward displacement of kidneys, as in the erect position, resulting in stretching and elongation of the renal arteries. This provides improved delineation of the entire length of the renal arteries and reduces overlap of other aortic branches. In addition, it is a useful means to graphically demonstrate and evaluate the association between ptosis and renal arterial lesions.

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California U. [Brain Research Inst.] Los Angeles.

THE UROLOGICAL PROBLEMS IN SPACE MEDICINE, by A. T. K. Cockett. [1964] [4]p. incl. illus. diagr. (AF AFOSR-61-81)   Unclassified

Presented at annual meeting of the Calif. Medical Assoc., Los Angeles, Mar. 24-27, 1963.

Published in Jour. Urol., v. 92: 564-567, Nov. 1964.

The purpose of this paper is to review recent developments which provide partial solutions to 2 potential urological hazards: (1) urinary calculi and (2) decreased urine flow.

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California U. Brain Research Inst., Los Angeles.

ELECTRODE SYSTEM FOR RECORDING EEG FROM PHYSICALLY ACTIVE SUBJECTS, by R. T. Kado, W. R. Adey, and J. R. Zweizig. [1964] [1]p. incl. diagr. (AFOSR-65-0941) (AF AFOSR-63-246) AD 622895
                                        Unclassified

Also published in Seventh annual Conf. on Eng. in Med. and Biol., Cleveland, Ohio, Nov. 1964, p. 5.

An electrode system is presented which is designed to produce good electroencephalographic recordings despite moderate movements of the subject. A simple tin electrode in a stannous chloride solution is used. The metal part and the electrolyte are contained in a semipermeable ceramic shell. The electrolyte is prepared in dry form containing $SnCl_2 \cdot 2H_2O$, Kaolin, Silica gel, and Natrosol. The prepared cup is then activated for use by immersion in distilled water. Contact between the skin and electrode is established by a cylindrical cellulose acetate sponge hollowed at one end to accept the cup assembly. A microdot minninoise coaxial cable is used to eliminate cable artifacts. The system is reported to have worked well on active subjects engaged in normal functions.

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California U. [Brain Research Inst.] Los Angeles.

RENAL LYMPH AND ANTIBACTERIAL LEVELS IN
THE TREATMENT OF PYELONEPHRITIS, by Y. J.
Katz, A. T. K. Cockett, and R. S. Moore. [1964]
[14]p. incl. illus. diagrs. table, refs. (AFOSR-65-
0964) (AF AFOSR-63-246) AD 619107
Unclassified

Also published in Life Sct., v. 3: 1249-1262, 1964.

A method for the cannulation of renal lymphatics is
described. A 2-3 fold increase in lymph concentrations
of nitrofurantoin over plasma was observed 1-1/2 to 2
hr after infusion by gastric tube. Maximal microbio-
logical acttvity against E. coli was noted in the renal
lymph at 1-1/2 to 2 hr. The hilar lymph tics were also
cannulated. It appeared that these vessel, draining
the medulla contained a sttll higher concentration of the
antibacterial. The kidney interstitium diverted bacteri-
ologically acttve nitrofurantoin into the renal lymphat-
ics. An antimicrobial assay of renal lymph along with
urine and blood levels is indicated to determine the
effectiveness of any therapeuttc agent.

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California U. Brain Research Inst., Los Angeles.

THE EFFECTS OF VARIOUS IONS ON RESTING AND
SPIKE POTENTIALS OF BARNACLE MUSCLE FIBERS,
by S. Hagiwara, S. Chichibu, and K.-I. Naka. [1964]
[17]p. incl. diagrs. tables, refs. (AFOSR-65-0047)
(AF AFOSR-64-535) AD 455016 Unclassified

Also publtshed in Jour. Gen. Physiol., v. 48: 163-
179, Sept. 1964.

Effects of moncvalent cations and some antons on the
electrical properties of the barnacle muscle ftber
membranes were studied when the intra- or extracellu-
lar concentrations of those ions were altered by longi-
tudinal intracellular injection. The resting potential
of the normal fiber decreases linearly with increase
of logarithm of $[K^+]_{out}$ and the decrement for a tenfold
increase in $[K^+]_{out}$ is 58 mv when the product,
$[K^+]_{out} \cdot [Cl^-]_{out}$, is kept constant. It also decreases
with decreasing $[K^+]_{tn}$ but is always less than expected
theoretically. The deviatton becomes larger as $[K^+]_{tn}$
tncreases and the resting potential finally starts to de-
crease with increasing $[K^+]_{tn}$ for $[K^+]_{in} > 250$ mM.
When the tnternal K^+ concentration is decreased the
overshoot of the spike potential increases and the time
course of the spike potential becomes more prolonged.
In substituttng for the tnternal K^+, Na^+ and sucrose
affect the resting and sptke potentials stmtlarly. Some
organic cattons (guantdtne, choline, tris, and TMA)
behave ltke sucrose while some other organic cations
(TEA, TPA, and TBA) have a specific effect and pro-
long the spike potenttal if they are applied intracellu-
larly or extracellularly. In all cases the active mem-
brane potential tncreases linearly with the logartthm
of $[Ca^{++}]_{out}/[K^+]_{in}$ and the increment is about 29 mv

for tenfold tncrease in tns ratio. The fiber membrane
is permeable to Cl^- and other smaller antons (Br^- and
I^-) but not to acetate and larger anions (cttrate,
sulfate, and methanesulfonate).

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Caltfornia U. Brain Research Inst., Los Angeles.

THE INITIATION OF SPIKE POTENTIAL IN BARNACLE
MUSCLE FIBERS UNDER LOW INTRACELLULAR
Ca^{++}, by S. Hagiwara and K.-I. Naka. [1964] [22]p.
incl. diagrs. table, refs. (AFOSR-65-0048) (AF
AFOSR-64-535) AD 455021 Unclasstfied

Also published in Jour. Gen. Physiol., v. 48: 141-162,
Sept. 1964.

Electrical properties of the muscle fiber membrane were
studted in the barnacle, Balanus nubilus Darw, by ustng
intracellular electrode techniques. A depolarization of
the membrane does not usually produce an all-or-none
spike potential in the normal muscle fiber even though
a mechanical response is elicited. The intracellular
injectton of Ca^{++} binding agents renders the fiber capable
of initiating all-or-none spikes. The overshoot of such
a spike potential increases with increastng external Ca
concentration, the increment for a tenfold tncrease in
Ca concentration being about 29 mv. The threshold
membrane potential for the spike and also for the K con-
ductance increase shifts to more positive membrane
potentials with increasing Ca^{++}. The removal of Na
ions from the external medium does not change the con-
figuration of the spike potential. In the absence of Ca^{++}
in the external medium, the spike potential is restored
by Ba^{++} and Sr^{++} but not by Mg^{++}. The overshoot of
the spike potential increases with increasing Ba^{++} or
Sr^{++}. (Contractor's abstract)

352

Californta U. Brain Research Inst., Los Angeles.

MEMBRANE PROPERTIES OF BARNACLE MUSCLE
FIBER, by S. Hagiwara, K.-I. Naka, and S. Chichibu.
[1964] [2]p. incl. diagr. (AFOSR-64-1707) (AF AFOSR-
64-535) AD 447599 Unclasstfted

Also published in Science, v. 143: 1446-1448,
Mar. 27, 1964.

Membrane properties of the giant muscle ftber of the
barnacle Balanus nubilus were studied by controlling
the ionic composttton of the external and internal media.
The resting potential decreases with tncreasing ex-
ternal K-concentratton, $[K^+]_{out}$, and decreasing internal
K-concentration, $[K^+]_{in}$, over a considerable range.
Spike potentials are elicited when the tnternal calcium
ions are removed, and the overshoot is determtned by
the ratio between $[Ca^{++}]_{out}$ and $[K^+]_{tn}$ and not by the
external or internal $[Na^+]$.

353

California U. [Dept. of Astronomy] Los Angeles.

A STUDY OF HIGH-PRECISION GEOCENTRIC AND
INTERPLANETARY ORBITS, by S. Herrick. [Final]
rept. Feb. 2, 1959-Apr. 30, 1963. Sept. 30, 1963,
20p. (Rept. no. 63-56) (AFOSR-5350) (AF 49(638)498)
AD 427653   Unclassified

The purpose of this contract is research into the theory
and application of astrodynamics in the fields of high-
precision geocentric and interplanetary orbits. De-
veloping along these parallel lines, the undertaking has
continually widened and deepened in scope since its
inception to include such practical matters as the im-
provement of the numerical values of the astrodynamic
constants, the computational advantages of various per-
turbation techniques, and use of universal variables, as
well as theoretical development along the lines of
optimization, rendezvous in space, and the adjoint
method in differential orbit improvement. These are
considered in the report. (Contractor's abstract)

354

California U. [Dept. of Astronomy] Los Angeles.

THE HYDROGEN TO HELIUM RATIO IN HD 96446, by
A. Cowley, L. H. Aller, and T. Dunham, Jr. [1963]
[7]p. incl. diagrs. tables. (AFOSR-65-1105)
(AF AFOSR-63-83) AD 621535   Unclassified

Also published in Publ. Astron. Soc. Pacific, v. 75:
141-147, Oct. 1963.

One of the brightest of the hydrogen-deficient stars in
HD 96446. Spectral scans of this star were taken, and
the method proposed by Unsöld was followed to get the
hydrogen/helium ratio: H/He ≈ 0.38. It is found that,
though HD 96446 is a hydrogen-deficient star, it is
not by any means an extreme example of this class.

355

California U. [Dept. of Astronomy] Los Angeles.

SPECTROPHOTOMETRY OF THE WOLF-RAYET
STAR γ_2 VELORUM, by L. H. Aller and D. J. Faulkner.
[1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-
1106) (AF AFOSR-63-83) AD 620481   Unclassified

Also published in Astrophys. Jour., v. 140: 167-172,
July 1, 1964.

A spectrophotometric study was undertaken of both
components of the binary γ Velorum. Observations of
γ_1 Velorum were difficult, but it appeared to have a
normal distribution for a B2 dwarf. The major part of
the study was concerned with the component γ_2 Velorum,
the brightest Wolf-Rayet star in the sky. Measurements
of the energy distribution in the continuum and of the
intensities of the brighter lines, due to helium, carbon,
and oxygen in various ionization stages, yielded excita-
tion temperatures dependent on the ionization stage, and
a color temperature near 30,000°K.

356

California U. [Dept. of Astronomy] Los Angeles.

SPECTROMETRIC STUDIES OF GASEOUS NEBULAE.
I. THE DOUBLE-RING PLANETARY NGC 7009, by
L. H. Aller and J. B. Kaler. [1964] [14]p. incl. illus.
tables, refs. (AFOSR-65-1107) (AF AFOSR-63-83)
AD 620483   Unclassified

Also published in Astrophys. Jour., v. 139: 1074-
1080, May 1964.

Spectrophotometric data obtained with a photoelectric
spectrum scanner at Mount Wilson Observatory in 1956
and Mount Stromlo Observatory in 1961 are combined
with photographic observations obtained with coudé spec-
trographs at Mount Wilson and Lick Observatories to
obtain intensities and identifications for the planetary
nebula NGC 7009 in the spectral region λ 3100-λ 4960.
Lines as weak as 0.02 on the scale I(Hβ) = 100 are meas-
ured on the longest exposure.

357

California U. [Dept. of Astronomy] Los Angeles.

SPECTROPHOTOMETRIC STUDIES OF GASEOUS
NEBULAE II. THE MODERATE-EXCITATION
PLANETARIES NGC 6572 and IC 4997, by L. H. Aller
and J. B. Kaler. [1964] [11]p. incl. tables, refs.
(AFOSR-65-1108) (AF AFOSR-63-93) AD 620484
                                Unclassified

Also published in Astrophys. Jour., v. 140: 621-631,
Aug. 15, 1964.

Observations made with the 100-in. coudé spectrograph
at Mount Wilson and the nebular spectrograph of the
Crossley reflector a Lick Observatory are used to ob-
tain line identifications and intensities for planetary
nebulae NGC 6572 and IC 4997 in the wavelength region
λλ 3070-4940. Lines as faint as 0.02 on the scale
I (Hβ) = 100 are observed.

358

California U. [Dept. of Astronomy] Los Angeles.

ELEMENTS AND EPHEMERIS OF 1948 OA AND
EPHEMERIS OF (1956) ICARUS, by S. J. Herrick and
K. C. Ford. [1964] [1]p. (AFOSR-65-0331) (AF
AFOSR-63-241) AD 611994   Unclassified

Also published in Jour. Minor Planets Circ., No. 2323,
Aug. 1, 1964.

The astronomical data is presented in tabular form.

359

California U. [Dept. of Astronomy] Los Angeles.

SOME PROBLEMS OF PLANETARY NEBULAE, by

L. H. Aller. [1964] [19]p. incl. diagrs. tables, refs. (AFOSR-65-2802) (AF AFOSR-65-83) AD 628828
Unclassified

Also published in Astrophys. Norvegica, v. 9: 293-311, Nov. 1964.

Considerable progress has been made in recent years in the study of planetary nebulae. Aside from the beautiful appearance of many of these objects with their double-ringed symmetries and delicate filaments, the main features of their spectra can be understood quantitatively as well as qualitatively in terms of fairly simple physical theories. More recent studies have sought connections between these objects and stellar evolution tracks of common stars and it is probable that the most exciting discoveries in the future will occur in this area. In this article an attempt is made to summarize not so much what is known about these objects but rather some of the outstanding problems, both observational and theoretical, which remain. Chief emphasis is on the spectroscopic problems.

360

California U. [Dept. of Astronomy] Los Angeles.

SPECTROPHOTOMETRIC STUDIES OF GASEOUS NEBULAE. III. THE LOW-EXCITATION RING PLANETARY IC 418, by L. H. Aller and J. B. Kaler. [1964] [7]p. incl. diagr. tables, refs. (AFOSR-65-2806) (AF AFOSR-65-83) AD 628456 Unclassified

Also published in Astrophys. Jour., v. 140: 936-941, Oct. 1, 1964.

Plates taken at the coudé and prime foci of the Lick 120-in. and at the Mount Wilson 100-in. coudé are combined to yield line intensities in the region λλ 3100-5000A for the bright, compact, rather regular nebula. IC 418. Line intensities are given both for the bright hydrogen ring and for a strip through the center of the nebula to show the effects of stratification. Average intensities that should approximate those of the integrated light of the nebula are also given. Intensities of emission lines from the central star have been measured and compared with the results of earlier work. (Contractor's abstract)

361

California U. Dept. of Chemistry, Los Angeles.

X-RAY STUDIES OF UNUSUAL ORGANIC COMPOUNDS, by K. N Trueblood, D. A. Bekoe and others. Final rept. Sept. 1, 1959-Dec. 31, 1962. Mar. 1963, 1v. incl. diagrs. tables, refs. (AFOSR-5135) (AF 49(638)-719) AD 416362 Unclassified

This report discusses the following unpublished work performed under this contract: The crystal structure of 5-keto-1,5-dihydrobenz(cd) indole; The crystal structure of the hexahydrated calcium salt of hexacyanoisobutene; The crystal structure of the cubic form of tetracyanoethylene; The crystal structure of 1,1-(tetramethylethylene) ferrocene; Miscellaneous struc-

tural studies; and Crystallographic computing. Reports and Publications—Crystallographic calculations on SWAC and on the IBM 709; Comparison of various least squares refinement techniques; Crystal structure of the diolefin of (2.2)paracyclophane; Crystal structure of trimethyloxosulfonium perchlorate; and Crystal structure of (3.3)paracyclophane.

362

California U. Dept. of Chemistry, Los Angeles.

CHEMICAL EFFECTS OF RADIATION, by W. F. Libby. Final technical rept. Jan. 15, 1963, 1v. incl. diagrs. tables, refs. (AFOSR-4664) (AF 49(636)901) AD 414457 Unclassified

The last 3 yr research on the chemistry of radiation and materials is described and analyzed. The following reports are given: Size effects among isotopic molecules; Optical transparency and resistance to flash heating; Isotope size effect in Van der Waals radii and the barrier to rotation around the carbon-carbon single bond; General theory particularly for the radiation induced cross linkage of polymers and polymerization of saturated hydrocarbons; Ultra rapid rates at very high pressures; Ion-molecule reactions in radiolysis of n-hexene at low temperatures; The theory of metallic diamond; Electron transfer among the transition elements; The controlling role of the Franck-Condon principle on rates: Theory of direct radiation induced cross bonding in hydrocarbons; The radiation chemistry of solid n-hexane at 77°K; Charge transfer in the radiolysts of solid n-Hexane; Metallic InSb at zero pressure; Crystal structure relative to tin; Superconductivity of metallic InSb. (Contractor's abstract)

363

California U. [Dept. of Chemistry] Los Angeles.

INDIUM ANTIMONIDE: SUPERCONDUCTIVITY OF THE METALLIC FORM, by H. E. Bommel, A. J. Darnell and others. [1963] [2]p. (AFOSR-64-0029) (AF 49(636)901) AD 435952 Unclassified

Also published in Science, v. 129: 1301-1302, Mar. 29, 1963.

The transition of metallic indium antimonide into the superconducting state begins at 2.1°K and is complete at about 1.6°K. These data are close to those for white tin. (Contractor's abstract)

364

California U. [Dept. of Chemistry] Los Angeles.

LIGHT EMITTED BY ATOMIC FLAMES, by K. D. Bayes. Final rept. Oct. 1, 1961-Oct. 31, 1964. (Combined operating rept. no. 2 - Nov. 1, 1963-Oct. 31, 1964) (AFOSR-64-2352) (AF AFOSR-62-62) Unclassified

The following two publications have resulted from this

research: (1) The origin of light emission in the atomic
hydrogen-acetylene flame and (2) ... olous low rota-
tional temperature in the emiss'~ spectrum of CO_2.
In addition, the method of res: .e fluorescence has
been investigated. Preliminary experiments con-
firmed the theoretical scattering intensities. Incom-
plete studies of the systems $H + C_3O_2$, $O + C_3O_2$, and
$O + CS_2$ were made. No results of these results are
patentable. (Contractor's abstract)

365

California U. Dept. of Chemistry, Los Angeles.

THE ORIGIN OF LIGHT EMISSION IN THE ATOMIC
HYDROGEN-ACETYLENE FLAME, by K. D. Bayes
and R. E. W. Jansson. [1964] [8]p. incl. diagr. refs.
(AFOSR-65-0376) (AF AFOSR-62-62) AD 612220
Unclassified

Also published in Proc. Royal Soc. (London), Series A,
v. 282: 275-282, 1964.

Acetylene catalyzes the gas phase recombination of
hydrogen atoms, and frequently the reaction is
accompanied by a bright flame. It is shown that the
light emission is not the result of the catalytic recom-
bination, but is caused by traces of water in the hydro-
gen. The possible reactive intermediates, OH, HO_2
and atomic oxygen, have been individually generated
and added to the mixture of hydrogen atoms and acetyl-
ene. Only oxygen atoms are effective in causing
luminescence. Hydrogen atoms are not necessary for
light emission, but they do alter the spectrum some-
what. Two different mechanisms for the formation of
electronically excited C_2 are required. The mechanism
for the reaction of atomic oxygen with acetylene is dis-
cussed. (Contractor's abstract)

366

California U. [Dept. of Chemistry] Los Angeles.

EMISSION AND DISSOCIATION OF NO_2 IN SHOCK
WAVES, by E. R. Hardwick. Final technical rept.
Sept. 18, 1963, 11p. (AFOSR-J1361) (AF AFOSR-62-
240) AD 428401 Unclassified

When compared with other kinetic data, the time de-
pendence of the emission of NO_2 in shock waves in the
vicinity of 2000°K supports the conclusion that the
intensity follows (NO_2) in this system. Study of the
emission from the system of CH_3NO_2Ar shows that
NO_2 appears following the shock, but that it has a very
short lifetime presumably reacting according to
$CH_3 + NO_2$ yields $CH_3O + NO$. (Contractor's abstract)

367

California U. [Dept. of Chemistry] Los Angeles.

MODELS FOR ASYMMETRIC INDUCTION TO POLY-
MERIZATION, by D. J. Cram. Final rept. Oct. 1,

1962-Oct. 1, 1964. Nov. 2, 1964, 3p. (AFOSR-64-
2483) (AF AFOSR-63-124) AD 609558 Unclassified

Studies on the reaction mechanisms for base-catalyzed
1,3- and 1,5-proton migrations in unsaturated systems
are briefly summarized.

368

California U. Dept. of Chemistry, Los Angeles.

BASE-CATALYZED INTRAMOLECULAR 1,3- AND
1,5-PROTON TRANSFERS, by D. J. Cram, F. Willey
and others. [1964] [2]p. incl. table. (AFOSR-65-2377)
(AF AFOSR-63-124) AD 629638 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86:
5370-5371, Dec. 5, 1964.

A report is made on observations of intra-molecular
proton (deuteron) transfers in a triene to give a tri-
arylmethane, and in an acetylene to give an allene.

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California U. Dept. of Chemistry, Los Angeles.

ELECTROPHILIC SUBSTITUTION AT SATURATED
CARBON. XXII. INTRAMOLECULAR HYDROGEN
TRANSFER REACTIONS IN BASE-CATALYZED
ALLYLIC REARRANGEMENTS, by D. J. Cram and
R. T. Uyeda. [1964] [12]p. incl. diagrs. tables, refs.
(AFOSR-65-2380) (AF AFOSR-63-124) AD 629639
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86:
5466-5477, Dec. 20, 1964.

The base-catalyzed rearrangement of 3-phenyl-1-
butene (I-h) to cis-2-phenyl-2-butene (II) in a variety
of media containing deuterium donors (ROD) was studied,
as has the rearrangement of 3-phenyl-1-butene-3-d (I-d)
in media containing proton donors. Only minor amounts
of trans-2-phenyl-2-butene (III) were produced in the
rearrangements. The rates of hydrogen-deuterium ex-
change of II and III were demonstrated to be 10^{-1} to 10^{-2}
slower than the isomerization of I under the same condi-
tions. Degradative experiments demonstrated that when
I-h was isomerized to II in deuterated solvents, all of
the deuterium introduced was in the 4-position of 2-
phenyl-2-butene (II). Isotopic exchange of I was slower
than isomerization in all media. In tert-butyl alcoh .-
O-d (potassium-tertbutoxide as base), (-)-I-h underwent
isotopic exchange at a rate at least 10 times faster than
racemization, both rates being vastly slower than the
isomerization rate. (Contractor's abstract)

370

California U. Dept. of Chemistry, Los Angeles.

ELECTROPHILIC SUBSTITUTION AT SATURATED
CARBON. XXIII. STEREOCHEMICAL STABILITY OF
ALLYLIC AND VINYL ANIONS, by D. H. Hunter and

D. J. Carm. [1964] [13]p. incl. diagrs. tables, refs.
(AFOSR-66-0024) (AF AFOSR-63-124) AD 629641
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86:
5478-5490, Dec. 20, 1964.

The potassium tert-butoxide catalyzed isomerization
and hydrogen-isotope exchange reactions of cis- and
trans-a-methylstilbene and a-benzylstyrene, and of cis-
and trans-stilbene, were studied in tert-buryl alcohol
and tert-butyl alcohol-O-d. The kinetics of deuterium
incorporation and of isomerization of cis and trans-
alpha-methylstilbene and alphy.-benzylstyrene into one
another can be made most internally consistent with a
mechanism which involves noninterconverting cis- and
trans-allylic anions as intermediates. The equilibrium
constants for interconversions of the 3 olefins were de-
termined, and the kinetic and thermodynamic data are
most consistent with one another on the basis of this
same mechanism. The allylic rearrangement of alpha-
benzylstyrene into cis-alpha-methylstilbene was shown
to proceed with 55% intramolecularity, and into trans-
alpha-methylstilbene with 36% intramolecularity. A
solvent kinetic isotope effect of $(CH_3)_3COD/(CH_3)_3COH$
~ 2 was observed for these isomerizations.

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California U. [Dept. of Chemistry] Los Angeles.

STUDY OF THE MOLECULAR AND CRYSTAL STRUC-
TURE OF ORGANIC COMPOUNDS OF UNUSUAL
GEOMETRY OR ELECTRONIC STRUCTURE, by K. N.
Trueblood. Final rept. Jan.-Dec. 1963. Apr. 1964,
69p. (AFOSR-64-1107) (AF AFOSR-63-240)
AD 601478   Unclassified

The report includes further development of applications
of high-speed computers in crystallographic structure
work. A description is given of a precise study of the
structure of tetracyanoquinodimethane, heteroaromatic
dibenzo-1, 3a, 4, 6a-tetraazapentalene, an amino-
troponeimine derivative with aromatic properties, and
a ferrocene derivative in which the 2 cyclopentadienyl
rings are joined by a 2-carbon bridge. Preliminary
reports are given of reinvestigations of the structures
of tetracyanoethylene and all di-p-xylylene. A de-
scription is given of the structure of the hydrated calci-
um salt of the unusual acid hexacyanoisobutylene.

372

California U. [Dept. of Chemistry] Los Angeles.

SUPERCONDUCTIVITY OF METALLIC INDIUM
TELLURIDE, by H. E. Bommel, A. J. Darnell and
others. [1963] [1]p. incl. diagr. (AFOSR-J1157)
(AF AFOSR-63-245) AD 423132   Unclassified

Also published in Science, v. 141: 3582, Aug. 28, 1963.

Metallic indium telluride is a superconductor with a
transitor temperature of 2.18°K. The critical mag-
netic field is about 800 gauss. (Contractor's abstract)

373

California U. Dept. of Chemistry, Los Angeles.

SUPERCONDUCTIVITY IN THE ARTIFICIAL
METALS: METAL INDIUM ANTIMONIDE, THE INDIUM-
ANTIMONIDE-TIN ALLOYS, AND METALLIC INDIUM
TELLURIDE, by B. R. Tittmann, A. J. Darnell and
others. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-
1663) (AF AFOSR-64-245) AD 624376   Unclassified

Also published in Phys. Rev., v. 135: A1460-A1462,
Aug. 31, 1964.

Superconductivity has been observed in metallic indium
antimonide, in the alloys of indium antimonide with tin,
and in indium telluride. The compounds and alloys were
prepared and stabilized at atmospheric pressure in the
way described by Darnell and Libby. Superconducting
transition temperatures and critical magnetic fields
were obtained by the eddy-current decay method used in
measuring resistivities. (Contractor's abstract)

374

California U. Dept. of Chemistry, Los Angeles.

ARTIFICIAL METALS: InSb, THE Sn ALLOYS WITH
InSb, AND METALLIC InTe, by A. J. Darnell and W.
F. Libby. [1964] [6]p. incl. diagrs. tables, refs.
(AFOSR-65-1664) (AF AFOSR-64-245) AD 624377
Unclassified

Also published in Phys. Rev., v. 135: A1453-A1459,
Aug. 31, 1964.

The metallic forms of indium antimonide, indium
telluride, and the metallic alloys InSbSn, InSbSn$_2$, and
InSbSn$_4$, were prepared at high temperature and high
pressure, cooked, and subsequently quenched to -197°C
before release of the pressure of 1 atm. The metastable
metallic forms can be retained at 1 atm pressure at
low temperatures indefinitely and studied conveniently.
InSb(II) and its metastable alloys with tin have lattice
parameters essentially identical with those of metallic
tin. The lattice parameter of the cubic form of indium
telluride is 6.177 ± 0.002A at 25°C. The compressi-
bilities of InSb(II), InSb(I) and of Sn(β) at -197°C are
0.9, 3.6, and 3.1 x 10^{-6} bar^{-1}, respectively. The
compressibilities of InTe(I) and InTe(II) at 25°C are
6.3 and 3.8 x 10^{-6} bar^{-1}, respectively. The heat of
transformation $\Delta H^0 210$, (1 atm) InSb(II) - InSb(I) is
4.77 ± 0.04 kcal per mol. The resistivity of InSb(II) at
77°K is 77 x 10^{-6} Ω-cm. The velocity of sound in
polycrystalline InSb(II) is approximately 3900 m/sec.
The Brimmel hardness numbers of InSb(II) and InSb(β)
at 77°K are 230 and 46 kg mm^{-1}. InTe(II) is diamag-
netic; its susceptibility is -0.14 emu g^{-1}

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California U. Dept. of Chemistry, Los Angeles.

INTENSE 584-A LIGHT FROM A SIMPLE CONTINUOUS
HELIUM PLASMA, by C. A. Jensen and W. F. Libby.

[1964] [5]p. incl. diagrs. refs. (AFOSR-65-1665)
(AF AFOSR-64-245) AD 624375   Unclasstfted

Also publtshed in Phys. Rev., v. 135: A1247-A1252,
Aug. 31, 1964.

A simple source for the productton of rontinuous cold
plasmas and intense line spectra associated with a
particular gas is described in its application to helium.
Plasma densities and temperatures have been measured
spectroscopically. When using helium or neon gas, the
device becomes an intense source of ionizing radiation
for studies of the chemical reactions induced by the
ionizing ultraviolet. The tntensity of thts radiation has
been measured with reasonable accuracy by very simple
photocells whtch are easily constructed in the laboratory
and are only sensitive to vacuum-ultraviolet radiation;
more than 10^{16} 584A photons/sec are emitted by a 30-w
source. The mechantsm is via ion-electron recombtna-
tion from a 1660°K plasma of $\sim 10^{13}$ ions/cm^3 denstty.

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California U. Dept. of Chemistry, Los Angeles.

POSITIVE-ION CHEMISTRY: HIGH YIELDS OF HEAVY
HYDROCARBONS FROM SOLID METHANE BY IONIZ-
ING RADIATION, by D. R. Davis and W. F. Ltbby.
[1964] [2]p. (AFOSR-65-1666) (AF AFOSR-64-245)
AD 624368   Unclassified

Also published in Science, v. 144: 991-992, May 22,
1964.

At 77°K, solid methane is polymerized rapidly and
efficiently to heavy hydrocarbons by cobalt-60 γ-rays.
Evidence tndtcates that the polymer is formed in direct
proportion to the radiation dose, with a conversion of
about one methane mol/100 ev of absorbed energy.
The product is a viscous oil consisting mainly of
saturated and highly branched hydrocarbons containtng
an average of about 20 carbon atoms/mol. This would
seem to be evidence for posittve-ion chemical reacttons
in the soltd state analogous to those previously reported
to occur in the gaseous state at pressures above 0.01
mm-Hg. It would thus appear that the solar ionizing
ultraviolet radiation (about 1 erg/cm^2/sec at the earth)
must polymerize methane at an appreciable rate under
many likely conditions.

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California U. Dept. of Chemistry, Los Angeles.

PREFATORY CHAPTER: THIRTY YEARS OF
ATOMIC CHEMISTRY, by W. F. Ltbby. [1964] 12p.
(AFOSR-65-1667) (AF AFOSR-64-245) AD 624365
Unclassified

Also published in Ann. Rev. Phys. Chem., v. 15:
1-12, 1964.

A review is prese.ited of the last 30 yr in the use of
nuclear phenomenology and techniques in rhemtstry
and of the application of chemtcal methods to nuclear
physics, together with some mention of pure physical

chemistry. In the latter portion of the article, are
reprinted remarks made at the dedication of Latimer
Hall at Berkeley.

378

California U. Dept. of Engineering, Los Angeles.

ON THE FINAL VALUE AND MINIMUM EFFORT
SYSTEMS, by H. C. Hsieh. [1963] [14]p. inrl. diagr.
refs. (AFOSR-J1142) (AF AFOSR-62-68) AD 423137
Unclassified

Also published in Jour. Franklin Inst., v. 276: 154-
167, Aug. 1963.

The synthesis is made of a final value system by using
the theory of eigenfunctions and the gradient methods
for adaptive control systems. The applirability of
these 2 approaches is explored, and it is shown that the
final value problems treated in this paper always include
the minimum effort problems. The concept of Adjcint
Space Approach to the solution of the problems will be
introduced. By using this approach, a great reduction
in the dimensionality of the problems can be achieved.
(Contractor's abstract)

379

California U. [Dept. of Engineering] Los Angeles.

THE LEAST SQUARES ESTIMATION OF LINEAR
AND NONLINEAR SYSTEM WEIGHTING FUNCTION
MATRICES, by H. C. Hsieh. [1964] [32]p. (AFOSR-
64-2414) (AF AFOSR-62-68) AD 453617
Unrlassified

Also published in Inform. Control, v. 7: 84-115, Mar.
1964.

The first part of this paper gives a general approach
to the least squares estimation of the weighting funrtion
matrtx of a linear multivariable system by using normal
operating records. It is shown that a great redurtion
in the dimensionality of the problem ran be achieved
by first obtaining a solution in the adjoint space. The
estimated weighting funrtion matrix is then determined
simply by operating on it with an adjoint operator.
When the identification proredure is used on-line with
the system operation, 2 recursive schemes are devised
to up-date the estimation to inrorporate adding new
data and deleting old data. Finally, the identtficacion
of a nonlinear system which ran be represented by a
power series expansion for a continuous functional
established by Frechet is discussed. A steepest desrent
method in the Hilbert space and its modifted version
are introduced as a practical means for solving this
estimation problem. (Contractor's abstract)

380

Californta U. Dept. of Engineering, Los Angeles.

AN OPTIMAL CONTROL PROBLEM WITH STATE

VECTOR MEASUREMENT ERRORS, by R. R. Schultz. [1964] [45]p. incl. refs. (AFOSR-65-1001) (AF AFOSR-62-68) AD 626510   Unclassified

Also published in Advances in Control Systems, Theory and Application, New York, Academic Press, v. 1: 197-243, 1964.

A discussion is presented of a specific stochastic optimal control problem. The problem is states as follows. given a system whose behavior is described by the vector matrix differential equation

$\frac{dx}{dt} = A(t)x(t) + B(t)u(t) + N(t)$, or by the equivalent

stochastic differential equation $dx(t, t+h) = A(t)x(t)h + B(t)u(t, x(t) + z(t)h + dN(t, t+h) + O(h)$; find the policy $u(t, x(t) + z(t))$ from all piecewise continuous linear functions of $x(t) + z(t)$ which minimizes the performance criterion. The method of dynamic programming developed by Bellman (Dynamic Programming, Princeton, Princeton U. Press, 1957), is used to obtain the solution. (Contractor's abstract)

381

California U. Dept. of Engineering, Los Angeles.

ON LINE COMPUTER CONTROL TECHNIQUES AND THEIR APPLICATION TO RE-ENTRY AEROSPACE VEHICLE CONTROL, by F. H. Kishi. [1964] [121]p. incl. diagrs. tables, refs. (AFOSR-65-1002) (AF AFOSR-62-68) AD 626510   Unclassified

Also published in Advances in Control Systems, Theory and Application, New York, Academic Press, v. 1: 245-357, 1964.

The major concern of this work has been the development of tools necessary to perform adaptation in a control problem with an unknown process. The approach taken to perform adaptive control was to measure the process through observation of the input-output data and to compute optimal controls on the basis of estimated parameter values and estimated state-variables. Three phases to this approach to adaptive controls are discussed: (1) parameter estimation; (2) state-variable estimation; and (3) computation of optimal controls. The three phases are studied separately indicating approaches which can accomplish these tasks. In the area of optimal control computations, methods presently available for the linear process case with quadratic performance criterion are summarized. For the parameter estimation phase two approaches are studied: (1) the explicit mathematical relation method, and (2) the learning model method. For the state variable estimation phase, Kalman's recursive filtering technique was adopted. Finally, an outline is given to apply the optimal-adaptive approach to a phase of the re-entry problem. (Contractor's abstract)

382

California U. [Dept. of Mathematics] Los Angeles.

OPTIMAL SPACING AND WEIGHTING IN POLYNOMIAL PREDICTION, by P. G. Hoel and A. Levine. [1964] [8]p. (AFOSR-65-1037) (AF AFOSR-62-158) AD 619110   Unclassified

Also published in Ann. Math. Statistics, v. 35: 1553-1560, Dec. 1964.

A solution is given to the problem of how to determine at which points in the interval [-1, 1] observations should be taken and what proportion of the observations should be taken at each such point so as to minimize the variance of the predicted value of a polynomial regression curve at a specified point beyond the interval observations. The solution obtained states that the points are to be chosen to be Chebychev points and the number of observations are to be selected proportional to the absolute value of the corresponding Lagrange polynomial at the specified point. The preceding Chebychev solution becomes the mintmax solution for the interval $(-1, t)$, provided $t > t_1 > 1$ where t_1 is a value satisfying a certain equation. Under the customary normality assumptions, the Chebychev solution to the prediction problem is used to construct a confidence band for a polynomial curve that will possess minimum width at any specified point beyond the interval of observations.

383

California U. [Dept. of Mathematics] Los Angeles.

METHODS FOR COMPARING GROWTH TYPE CURVES, by P. G. Hoel. [1964] [14]p. incl. table. (AFOSR-65-1406) (AF AFOSR-62-158) AD 623200   Unclassified

Also published in Biometrics, v. 20: 859-872, Dec. 1964.

One of the statistical problems arising in biological research is that of comparing a treated group with a control group of growing organisms. The problem is difficult because a realistic regression model is seldom available and the observed variables taken over time are not statistically independent as required by classical regression models. Certain aspects of such problems are considered. The efficiency of using only means of sets of observations is compared with using a polynomial regression model. A best unbiased test for a polynomial regression model is then considered and compared with a nonparametric method under the assumption that the observations are sufficiently far apart in time to be treated as uncorrelated. A study is made of the magnitude of error arising from using classical regression theory which ignores the existant correlation of variables.

384

California U. [Dept. of Mathematics] Los Angeles.

DIFFERENCE ANALOGUES OF GREEN'S IDENTITIES
FOR GRIDS IN R^n, by D. Suschowk. [1964] [11]p.
(AFOSR-64-2318) (AF AFOSR-63-77) AD 452327
Unclassified

Also published in Numerische Math., v. 6: 200-210,
1964.

The present work contains the derivation of the complete
Green's formulae, including boundary terms, for arbi-
trary rectilinear grids in any number of dimensions.

385

California U. Dept. of Mathematics, Los Angeles.

GENERALIZED RATIONAL APPROXIMATION, by
E. W. Cheney and H. L. Loeb. [1964] [15]p. incl.
refs. (AFOSR-65-0624) (AF AFOSR-63-77)
AD 614528   Unclassified

Also published in Jour. Soc. Indus. and Appl. Math.,
Series B, v. 1: 11-25, 1964.

An extension of Rice's theory of "varisolvent" function
families to what is termed generalized rational func-
tions is given. It is a further development of the
rational approximation problem, extending the charac-
terization theorem about linear approximations to the
rational case and giving special consideration to a
rational trigonometric form. (Contractor's abstract)

386

California U. [Dept. of Mathematics] Los Angeles.

ON SUITABLE MANIFOLDS, by R. F. Brown. [1964]
[5]p. (AFOSR-65-1039) (AF AFOSR-63-90)
AD 617856   Unclassified

Also published in Math. Scandinavica, v. 14: 174-178,
1964.

M is a manifold and G(M) denotes the group of all
homeomorphisms of M onto itself with the compact-
open topology. For a point e ∈ M, M is suitable if
there exists a continuous map θ: M → G(M) such that
θ(x)(x) = e and θ(e) = identity. This note shows that
when M is compact, suitability is equivalent to the
existence on M of a continuous multiplication which has
many of the properties of a group multiplication. A
definition is also given of suitability for differentiable
manifolds with a proof that such manifolds are paral-
lelizable.

387

California U. Inst. of Geophysics and Planetary Physics,
Los Angeles.

FIRST MOTIONS FROM SEISMIC SOURCES NEAR A

FREE SURFACE, by R. Burridge, E. R. Lapwood,
and L. Knopoff. Aug. 14, 1964, 25p. (AFOSR-85-
2132) (AF AFOSR-64-710) AD 629822   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
1889-1913, Dec. 1964.

The radiation patterns of first motions are calculated
for the sudden occurrence of an arbitrarily oriented
fault at the surface of a half space; the dislocation in
the fault plane is also arbitrarily oriented and is
assumed to occur over a very small area of the fault
plane. Initially the source is considered at a finite
depth and the solution is obtained by allowing the depth
to tend to zero. In general the results show a surprising
directionality for the radiation of SV. In the focal plane
projection the first motions of P and SH for a strike-
slip fault show the familiar four-lobed radiation pat-
terns. The first motions of SV show some reversals
in polarity with angular distance from the source. The
first motions for all components of motion for a dip-slip
fault have characteristics governed strongly by the
presence of the free surface, and hence differ markedly
from the usual radiation patterns for a deeply imbedded
source.

388

California U. [Dept. of Mathematics] Riverside.

A GENERALIZATION OF SPITZER'S COMBINATORIAL
LEMMA, by H. D. Brunk. May 28, 1963, 11p.
(AFOSR-64-1589) (AF AFOSR-62-139) AD 446531
Unclassified

Also published in Zeitschr. Wahrscheinlichkeitstheorie,
v. 2: 395-405, 1964.

A simple combinatorial lemma in a study of partial
sums of independent identically distributed random
variables is the key tool in the present investigation.
It yields a one-one correspondence between ordered
subsets and permutations as represented cycles. If
X1,...,Xn are exchangeable random elements, not
necessarily real-valued, and M is a generalized mean
value, to the random vector is made to correspond a
decomposition into cycles; one concludes that the possi-
bility distribution of a function of these cycles is inde-
pendent of the generalized mean value M. Included are
results and observations identifying distributions of
certain statistics with that of the number of cycles in
a randomly chosen permutation. Another application
yields a theorem of Bohnenblust concerning statistics
determined by sign functions. Finally, the distribution
problem is solved for a proposed test against trend for
medians. (Contractor's abstract)

389

California U. [Dept. of Mathematics] Riverside.

INTEGRAL INEQUALITIES FOR FUNCTIONS WITH
NON-DECREASING INCREMENTS, by H. D. Brunk.
[1964] [11]p. (AFOSR-65-0341) (AF AFOSR-62-139)
AD 611993   Unclassified

Also published in Pacific Jour. Math., v. 14: 783-793, 1964.

The inequality $\int_{[\alpha,\beta]} f[X(t)]dG(t) \geq f[\int_{[\alpha,\beta]} X(t)dG(.)]$ is established if either (1) $G(\alpha) = 0$ or (2) $X(\alpha) \geq 0$, and if (3) $0 \leq G(t) \leq 1$ for $\alpha \leq t \leq \beta$, where X is a map from the real interval $[\alpha, \beta)$ into an interval in k-dimensional Euclidean space R^k such that each component of X is non-decreasing, and the function f is a map from R^k into the reals. The property of f critical for the inequality is that of having nondecreasing increments. K-dimensional analogues to other inequalities are considered including the inequality $\int_{[\alpha,\beta]} f[X(t)]\,dH(t) \geq 0$ for given conditions on H.

390

California U. [Dept. of Mathematics] Riverside.

QUASI-CONVERGENT SERIES OF INDEPENDENT RANDOM VARIABLES, by H. G. Tucker. [1963] [5]p. (AFOSR-64-0357) (AF AFOSR-62-328) AD 433169
Unclassified

Also published in Amer. Math. Monthly, v. 70: 718-772, Aug.-Sept. 1963.

Since the Levy concentration function of a distribution function is invariant under change of location parameter, it is reasonable to expect that quasi-covergence of a series of independent random variables should be characterizable in terms of the concentration function. K. Ito's theorem was obtained in terms of the concentration functions of sequence of partial sums using characteristic functions. In probability theory, results are obtained by the use of characteristic functions if needed, but it is preferable to obtain results in a more direct manner. The purpose of this note is to show how Ito's theorem can be obtained directly from properties of concentration functions. Some well-known results are obtained as corollaries to this theorem.

391

California U. [Dept. of Mathematics] Riverside.

ON CONTINUOUS SINGULAR INFINITELY DIVISIBLE DISTRIBUTION FUNCTIONS, by H. G. Tucker. [1964] [6]p. (AFOSR-64-0975) (AF AFOSR-62-328) AD 440154
Unclassified

Also published in Ann. Math. Stat., v. 35: 330-335, Mar. 1964.

The main purpose of this paper is to give sufficient conditions that a continuous singular F be obtained from a discrete G. These conditions are not too broad; however, these conditions should be of considerable interest in that they are obtained by purely probabilistic methods, there being no use made of the Riemann-Lebesque lemma, and thus supply more insight into the structure of continuous singular infinitely divisible distributions. Lemma is proved which might be of independent interest. This lemma is used to prove that every m-fold convolution of F, be continuous singular.

392

California U. [Dept. of Mathematics] Riverside.

LIMIT DISTRIBUTIONS OF A BRANCHING STOCHASTIC PROCESS, by H. H. Stratton, Jr. and H. G. Tucker. [1964] [9]p. incl. refs. (AFOSR-64-1721) (AF AFOSR-62-328) AD 448255
Unclassified

Also published in Ann. Math. Stat., v. 35: 557-565, June 1964.

The purpose of this paper is to find an approximate distribution of $X_N(t)$ when t is fixed (not necessarily large) but the initial size of the population, N, is large. If N is allowed to tend to infinity, and if the parameters of the process are made to change in a way analogous to the Poisson approximation of a binomial distribution, then it is shown that a limiting distribution of the process $X_N(t) - N$ exists as $N \to \infty$, and this limiting distribution is the distribution of a continuous process with independent increments. The relation between the parameters of the infinitely divisible distribution of the limiting process and the sequence of branching processes is exhibited.

393

California U. [Dept. of Mathematics] Riverside.

BOUNDED GENERALIZED ANALYTIC FUNCTIONS ON THE TORUS, by V. L. Shapiro. [1964] [10]p. incl. refs. (AFOSR-65-1797) (AF AFOSR-63-351) AD 626509
Unclassified

Also published in Pacific Jour. Math., v. 14: 1413-1422, 1964.

Let $v \in R^n$ have rationally independent coordinates so that the one-parameter subgroup, $G_v = \{(\exp(2\pi i v_1 t, \ldots, \exp(2\pi i v_n t): t \in R\}$, of the torus T^n is dense in T^n. Let A_v denote the set of f in $L_\infty (T^n)$ for which the mth Fourier coefficient $f(m) = 0$ for all lattice points m with $(m, v) \leq 0$, while $B_v \subset A_v$ consists of those f with $\hat{f}(m) = 0$ whenever $(m, v) \leq \gamma |m|$, for some positive $\gamma = \gamma_f < 1$. It is shown that for f in a class C_v between B_v and A_v, if f is Abel summable to zero for x in a subset of G_v of positive linear measure, then $f = 0$ in L_∞; the same holds if, instead of f Abel summable to zero, $\lim_{h \to 0+} f_h(x) = 0$, where $f_h(x)$ is the average value of f over the open ball about x of radius h. The result is shown to fail for A_v, and also for all v with rationally dependent coordinates.

394

California U. Dept. of Physics, Riverside.

SCATTERING OF SPIN WAVES BY MAGNETIC DEFECTS, by J. Callaway. [1963] [7]p. (AFOSR-64-0465) (AF AFOSR-62-318) AD 435658 Unclassified

Also published in Phys. Rev., v. 132: 2003-2009, Dec. 1, 1963.

The scattering of spin waves by magnetic point defects is considered using a Green's function method. A partial-wave expansion for the scattering amplitude is derived. An expression for the cross section is determined which includes the effect of resonant states. Application is made to the calculation of the thermal conductivity of an insulating ferromagnet.

395

California U. [Dept. of Physics] Riverside.

THERMAL RESISTANCE PRODUCED BY POINT IMPERFECTIONS IN CRYSTALS, by J. Callaway. [1963] 9p. (AFOSR-64-1235) (AF AFOSR-62-318) AD 442806   Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 883-891, Aug. 16, 1963.

A nonperturbation approach to the scattering of phonons by point imperfections is discussed, which includes the possibility of resonant scattering. The theory is applied to the calculation of the thermal resistance produced by mass defects. (Contractor's abstract)

396

California U. [Dept. of Physics] Riverside.

SCATTERING OF SPIN WAVES BY MAGNETIC DEFECTS, by J. Callaway and R. Boyd. [1964] 8p. (AFOSR-64-1773) (AF AFOSR-62-318) AD 449056   Unclassified

Also published in Phys. Rev., v. 134: 1655-1662, June 15, 1964.

A previous calculation of the scattering amplitude for the scattering of spin waves by magnetic defects in a simple cubic lattice is simplified and extended to body-centered and face-centered cubic lattices. Expressions are given for the mean free path, and the thermal resistivity due to defect scattering is calculated by a method which takes some account of spin-wave interactions. (Contractor's abstract)

397

California U. Dept. of Physics, Riverside.

THEORY OF SCATTERING IN SOLIDS, by J. Callaway. [1964] 53p. incl. refs. (Technical rept. no. 2) (AFOSR-64-1774) (AF AFOSR-62-318) AD 438130   Unclassified

Also published in Jour. Math. Phys., v. 5: 783-798, June 1964.

The general theory of the scattering of excitations in solids by localized imperfections is discussed. The solid state analog of the usual partial wave expansion of the scattering amplitude is derived. In an appendix,

the applicability of the general theory to phonons and spin waves as well as electrons is discussed. (Contractor's abstract)

398

California U. [Dept. of Physics] Riverside.

SPIN WAVE-SPIN WAVE SCATTERING IN A HEISENBERG FERROMAGNET, by R. G. Boyd and J. Callaway. [1964] [2]p. (AFOSR-54-1775) (AF AFOSR-62-318) AD 449054   Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 540-541, May 11, 1964.

An exact expressions has been obtained for the scattering cross section of two spin waves in a simple cubic Heisenberg ferromagnet by solving the Lippmann-Schwinger equation by methods discussed in detail elsewhere. (Contractor's abstract)

399

California U. Dept. of Physics, Riverside.

HIGH-TEMPERATURE MAGNETIC SUSCEPTIBILITY OF INTERACTING ELECTRONS IN A SOLID, by J. Callaway and D. M. Edwards. [1964] [8]p. incl. refs. (AFOSR-65-0802) (AF AFOSR-62-318) AD 616220   Unclassified

Also published in Phys. Rev., v. 136: A1333-A1340, Nov. 30, 1964.

Discussion is presented on a pair of electrons in an energy band which interact through a short-range potential. The scattering amplitude is determined exactly, and the energies of states in which the 2 particles are bound together are found. The change in the density of 2 particle states produced by the interaction is computed and used to calculate the second virial coefficient occurring in the expansion of the logarithm of the partition function in powers of the density. Inclusion of an external magnetic field allows determination of the magnetic susceptibility at high temperatures. The result has a form equivalent to that obtained in Stoner's theory of ferromagnetism, thereby justifying that theory in the high-temperature region and yielding an expression for the molecular-field parameter θ'.

400

California U. Dept. of Physics, Riverside.

ENERGY BANDS IN BODY-CENTERED AND HEXAGONAL SODIUM, by J. A. Hughes and J. Callaway. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0803) (AF AFOSR-62-318) AD 616221   Unclassified

Also published in Phys. Rev., v. 136: A1390-A1397, Nov. 30, 1964.

The band structures of both the body-centered cubic and the hexagonal close-packed phases of sodium have

been computed using a pseudopotential method. The pseudopotential parameters were obtained from spectroscoptc data for the free sodium atom. The Fermi surface is nearly sphertcal in both phases, with the maximum distortion being of the order of 1/4%. Within the accuracy of the calculatton, the Fermt energy and effecttve mass are the same in the 2 phases.

similarly deftned. Their group rings, the set of all combinations of $P^L(g)$ and $P^R(g)$, are denoted L*(G) and R*(G). It is noted that matrices in L*(G) and R*(G) commute, and a matrix that commutes with any $P^R(g)$ is a member of L*(G). These facts are used in an inductive proof on an ordered, ascending chain of subgroups of G to obtain the theorem.

401

California U. Dept. of Mathematics, Santa Barbara.

THE INVERSE MULTIPLIER FOR ABELIAN GROUP DIFFERENCE SETS, by E. C. Johnsen. [1964] [10]p. incl. refs. (AFOSR-65-2067) (AF AFOSR-65-698) AD 629035   Unclasstfted

Also published in Canad. Jour. Math., v. 16: 787-796, 1964.

A v, k, λ abelian group difference set (G, D) is a k-subset of elements $D = \{d_i\}$, $i = 1, \ldots, k$, taken from an abelian group G of order v such that each element $\neq 1$ in G appears exactly λ times in the set of differences $\{d_i d_j^{-1}\}$, where $0 < \lambda < k < v - 1$. A multtplter of (G, D) ts an automorphtsm $\emptyset$ of G under whtch $D^\emptyset = Da$, $a \in G$. Here we investigate the situation where (G, D) has the inverse multiplter $\iota: g \to g^{-1}$, $g \in G$. The following theorems are the princtpal results of the paper. Theorem. If ι is a multiplier of (G, D) then both v and λ are even, $k - \lambda$ is a square $m^2 \geq 4$, and $m \mid gcd (v, k, \lambda)$. Parametrically, we may write

$$v = \frac{m}{\alpha}[(m + \alpha)^2 - 1], \quad k = m (m + \alpha), \quad \lambda = m\alpha, \text{ where}$$

$\alpha \geq 1$ is an integer dividing $m^2 - 1$. The values of m and λ have opposite parity. If we consider these possible v, k, λ configurations to withtn complements and take $2 k < v$, then $\alpha \leq m - 1$. Theorem. If the Sylow 2 - subgroup of G in (G,D) is the direct product of s cyclic subgroups where $2^s < k/\lambda + 1 = m/\alpha + 2$, then ι ts not a multiplier of (G, D). Corollary. If G tn (G, D) is cyclic then ι (- 1 tf we represent G by the additive group of tntegers modulo v) ts not a multiplier of (G, D).

402

California U. Dept. of Mathemattcs, Santa Barbara.

UNIMODULAR GROUP MATRICES WITH RATIONAL INTEGERS AS ELEMENTS, by R. C. Thompson. [1964] [8]p. (AFOSR-65-2068) (AF AFOSR-65-698) AD 627630   Unclasstfied

Also publtshed in Pacific Jour. Math., v. 14: 719-726, 1964.

The following theorem is proved: For a finite solvable group G, A ts a unimodular matrix of rational integers such that B = AA' is a group matrtx for G. Then A = $A_1 T$ where A_1 is a unimodular group matrix of rattonal tntegers for G and T is a generalized permutation matrix. The left regular representatton of G ts defined by the matrix equations: $(gg_1, gg_2, \ldots, gg_n) = (g_1, g_2, \ldots, g_n) P^L(g)$ where $g_1, g_2, \ldots, g_n$ are ordered elements of G and $g \in G$. The right regular representation is

403

California U. [Dept. of Psychology] Santa Barbara.

INTERNATIONALISM-ISOLATIONISM, STRATEGY OF THE OTHER PLAYER, AND TWO-PERSON GAME BEHAVIOR, by C. G. McClintock, A. A. Harrison and others. [1963] [6]p. (AFOSR-64-1157) (AF 49(638)-794) AD 442832   Unclasstited

Also published in Jour. Abnorm. and Social Prychol., v. 67: 631-636, 1963.

Twenty-four tnternationalistic and 24 isolationistic Ss played a sertes of 60 modified Prisoner's Dilemma games. Unknown to the Ss, E assumed the role of the 'other player' and utilized strategies of 85%, 50%, or 15% cooperative responses. The results indicated: (1) isolationists make more competitive responses, (2) the number of competitive responses increases over blocks of trials, (3) there is an tnteraction between personality and trial blocks, and (4) the strategy of the other player does not significantly affect behavior. Two posstble interpretations of the relationshtp between isolationis.n-tnternationalism and game playing behavior are suggested: (1) isolationists employ strategies to maximize their gains and their opponents' losses, and/or (2) isolationists have a generalized tendency to compete. (Contractor's abstract)

404

California U. [Dept. of Psychology] Santa Barbara.

GROUP SUPPORTS AND THE BEHAVIOR OF LEADERS AND NONLEADERS, by C. G. McClintock. [1963] 9p. (AFOSR-64-1166) (AF 49(638)794) AD 442833   Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 67: 105-113, 1963.

In order to observe systemattc behavioral differences between leaders, joiners, and nonjoiners, 17 Ss in each category were placed in a condition of group support followed by one of group nonsupport. In both conditions, one S from one of the three categories interacted with three paid parttcipants in an attempt to solve a relatively unstructured task. As hypothestzed, leaders made stgntficantly more positive affect responses than nonjoiners across both situations and leaders made stgnificantly fewer negative responses under support and stgniftcantly more negative responses under nonsupport than nonjoiners. One major hypothesis was not substantiated: Leaders did not make significantly more task oriented responses than etther of the other categories under support or nonsupport. (Contractor's abstract)

405

Callery Chemical Co., Pa.

HEAT OF REACTION OF NITROGEN TRIFLUORIDE
WITH ELEMENTAL BORON, by J. R. Ludwig and W.
J. Cooper. [1963] [2]p. incl. table. (AFOSR-J1475)
(AF 49(638)1052) AD 426511   Unclassified

Also published in Jour. Chem. Eng. Data, v. 8: 76,
Jan. 1963.

Heat evolved in the reaction of nitrogen trifluoride with
crystalline elemental boron has been measured in a
bomb calorimeter. The heat of reaction calculated
from these data is -239.7 ± 1.2 kcal mol^{-1}. Derived
heat of formation of nitrogen trifluoride is $-30.4 \pm$
1.2 kcal mol^{-1}. (Contractor's abstract)

406

Cambridge Language Research Unit (Gt. Brit.).

A PRELIMINARY INTERPRETATION OF MASS, by
E. W. Bastin and C. W. Kilmister. Feb. 1963, 32p.
(Rept. no. ISU 10) (AFOSR-5049) (AF 61(052)331)
AD 413869   Unclassified

A report in algebraic hierarchy was formulated by A.
F. Parker-Rhodes without any physical interpretation.
It is now assumed that particular hierarchy of this
general type corresponds to a proton or an electron in
certain circumstances—the whole hierarchy being
necessary to represent the whole complex of observa-
tions of it. The present paper starts from this assump-
tion and in it are applied constraints to the process of
hierarchy construction in such a way that it enables
decomposition of hierarchy into 2 independent parts
for the purpose of representing unstable particles that
disintegrate into at least 2 decay products. (Contrac-
tor's abstract)

407

Cambridge Language Research Unit (Gt. Brit.).

A BROUWER TYPE SPACE TO REPLACE THE
CONVENTIONAL PHYSICAL CONTINUUM WHEN
PARTICLES ARE REGARDED AS DISTINCTION SYS-
TEMS, by E. W. Bastin and C. W. Kilmister. Nov.
1963, 34p. (AFOSR-64-1380) (AF 61(052)331)
AD 604044   Unclassified

An ordered distinction system arises when entities
specified by a set of properties each of which may be
present or absent are considered, and when the growth
of our knowledge in time is taken into account. It is
shown that all such systems have certain sets of integers
corresponding to them, and the structure of these sets
is considered.

408

Cambridge Language Research Unit (Gt. Brit.).

PROCEEDINGS OF A COLLOQUIUM ON THE SEMAN-
TIC BASIS OF COMMUNICATION HELD IN FLORENCE,
ITALY, SEPTEMBER 1963, by M. M. Materman.
Annual summary rept. Apr.-Aug. 1963. Apr. 1, 1964,
129p. (AFOSR-64-1036) (AF 61(052)647) AD 601198
                    Unclassified

A year's research on the semantic of human communica-
tion leading to a colloquium at Florence and a report
theorem are presented.

409

Cambridge Language Research Unit (Gt. Brit.).

THE COMMUNICATION OF ALGORITHMS, by A. F.
Parker-Rhodes. 1964, 8p. (AFOSR-64-1384)
(AF 61(052)647) AD 444446   Unclassified

Also published in Comput. Jour., v. 7: 28-35, Apr.
1964.

This paper introduces a programming-language of new
kind, intended to be usable as a high-level language
or as a low-level language according to the program-
mer's immediate requirements, and to provide for the
handling of data of any degree of complexity. The main
features of the language are explained by deriving them
step-by-step from a colloquial description of a fairly
typical algorithm, that of merging two alphabetic lists.
Subsequently, some additional facilities are described
and a specimen complete program is given. This does
not amount to a formal exposition of the language syn-
tactically, but should suffice for those interested to get
acquainted with its use. Further experience of its
application to various problems must be gathered before
a definitive syntactic definition is provided. (Contrac-
tor's abstract)

410

Cambridge Language Research Unit (Gt. Brit.).

SEMANTIC BASIS OF COMMUNICATION, by Y. Wilks,
D. Shillan and others. Final rept. Dec. 31, 1964
[114]p. incl. illus. diagr. refs. (AFOSR-65-0513)
(AF 61(052)647) AD 614093   Unclassified

A semantic recognition procedure is defined in which
interlingually coded text is machine searched with an
inventory of semantic targets. From the result of this
search a final message structure for a text is con-
structed by means of a system of rules for 'semantic
well-formedness.' A theory of intonational forms, and
phonetic recognition procedures relevant to it are de-
scribed. What it would be, using these procedures and
experimental results, to verify Guberina's hypothesis
about the relation of phonetic and semantic structures
in text, is suggested.

411

Cambridge Language Research Unit (Gt. Brit.).

COMMENTARY OF THE GUBERINA HYPOTHESIS, by
M. [M.] Masterman. 1963, 33p. (AFOSR-65-2247)
(AF 61(052)647) AD 629254   Unclassified

Also published in Rtv. Methodos, v. 15: 139-168, 1963.

Comments are made on the hypothesis of Peter Guberina
that there exists a single formula of semantic progres-
sion at the basis of all human communication. The
hypothesis is expounded in the paper 'La logique de la
logique et la logique du langage' (Zagreb, post 1954) and
the book 'Valeur logique et valeur stylistique des
propositions complexes' (Paris, 1939, and Zagreb,
1954). The hypothesis is regarded as a new generative
idea in the basis research into mechanical translation.
Guberina sees language as a multiple contrast system
made up of 2 units and 3 relations, with single systems
of semantic classifiers and one formula (the 'semantic
square'), of which all other semantic or syntactic forms
actually found in language must be construed either as
variants or as abbreviations. The 2 units are a general-
ized subject of discourse, or subject, and the most gen-
eralized possible version of what is said about it, or
predicate. The relations are inclusion, solidarity or
semantic overlap or cognateness, and descriptive impli-
cation.

412

Cambridge Language Research Unit (Gt. Brit.).

REPORT ON THE CALCULATIONS OF CYCLE
LENGTHS, by [E. W.] Bastin and M. Roy. Dec. 1,
1964 [18]p. incl. diagr. tables. (AFOSR-65-1322)
(AF EOAR-64-63) AD 622584   Unclassified

An algebraic system is considered in which infinitely
proceeding sequences, representing the inflow of data
into an information processing system of a hierarchical
type, are expressed in the form of matrix transforms
of vectors which cycle. Such an algebra is thought to
have special connection to the physics of elementary
particles. In this investigation, calculations of cycle
lengths are made, so that a complete set of data exist
from which detailed comparison with experiment can be
made. It also is proved that all cycles of an n x n
matrix are obtained by a standard form. Preliminary
comparisons of the spectrum of cycles with the spectrum
of masses of elementary particles were not successful.

413

[Cambridge U.] Cavendish Lab. (Gt. Brit.).

THE WORK-HARDENING CHARACTERISTICS OF Cu
AND α-BRASS SINGLE CRYSTALS BETWEEN 4·2 AND
500°K, by T. E. Mitchell and P. R. Thornton. [1963]
[32]p. incl. diagrs. tables, refs. (AFOSR-J893)
(AF 61(052)98) AD 415988   Unclassified

Also published in Philos. Magazine, v. 8: 1127-1159,
July 1963.

Shear stress-shear strain curves of Cu and α-brass
single crystals have been obtained over a wide range of
alloy compositions, temperatures, initial orientations
and strain rates. Analysis of the work-hardening char-
acteristics leads to the following main conclusions:
(1) for Cu the work-hardening rate during easy glide
increases with temperature; (2) in α-brass stage I ends
when the resolved shear stress on the conjugate system
equals the initial resolved shear stress on the primary
system; (3) the extent of easy glide increases with de-
creasing temperature and increasing alloy content,
and the temperature dependence of easy glide decreases
with increasing alloy content; (4) the work-hardening
rate θ_{11} during stage II is greater for orientations near
symmetrical positions, and this orientation dependence
is found at 4·2, 77 and 295°K for both Cu and α-brass;
(5) θ_{11} increases with decreasing temperature,
especially in the alloys; (6) the temperature dependence
of θ_{11} for pure metals is very similar to that of the flow
stress at high strains; (7) the work-hardening rate in
stage III of Cu crystals varies linearly with temperature
and ln ϵ; (8) in 70: 30 brass overshoot is independent of
temperature, but in Cu and the low Zn content alloys
more overshoot occurs at low temperatures.

414

Cambridge U. Cavendish Lab. (Gt. Brit.).

WORK-HARDENING IN NIOBIUM SINGLE CRYSTALS,
by T. E. Mitchell, R. A. Foxall, and P. B. Hirsch.
[1963] 24p. (AFOSR-64-0456) (AF 61(052)98)
AD 435916   Unclassified

Also published in Philos. Magazine, v. 8: 1895-1920,
Nov. 1963.

The work-hardening properties of niobium single
crystals grown by electron-beam zone-melting have
been investigated over a wide range of purities, orienta-
tions, temperatures and strain-rates. Three stages of
hardening are observed after the onset of plastic flow.
The nature of the slip lines observed in stage I is com-
patible with the view that some cross-slip of screw
dislocations occurs and that edge dislocations slip much
further than screws. (Contractor's abstract)

415

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE DETECTION OF SECONDARY SLIP DURING THE
DEFORMATION OF COPPER AND ALPHA-BRASS
SINGLE CRYSTALS, by T. E. Mitchell and P. R.
Thornton. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-
0762) (AF 61(052)98) AD 617632   Unclassified

Also published in Philos. Magazine, v. 10: 315-323,
Aug. 1964.

Deviations from single glide during the deformation of
Cu single crystals have been detected by following the
orientation of the tensile axis using x-ray techniques.
The deviations for room temperature deformation of
some crystals can be explained if it is assumed that
5-10% of the elongation is produced by slip on the

secondary systems and the remainder on the primary system. The deviations from single glide are much smaller in α-brass crystals which also show more over-shoot, so that secondary slip is inhibited. It is suggested that secondary slip is produced near the heads of piled-up groups of primary dislocations at the ends of newly formed slip lines where the resolved shear stress on the secondary systems is high. Secondary slip is thus very localized, producing little strain, but it can give rise to a high forest density.

416

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE ALUMINUM-TECHNETIUM SYSTEM. THE NEW PHASES $TcAl_{12}$, $TcAl_4$ AND Tc_2Al_3, by L. M. d'Alte da Veiga and L. K. Walford. [1963] [1]p. (AFOSR-J365) (AF EOAR-61-24) AD 407712   Unclassified

Also published in Philos. Magazine, v. 8: 349, Feb. 1963.

The aluminum-technetium system has been investigated. In the present note the existence of a further 3 previously unknown phases is reported: $TcAl_{12}$, $TcAl_4$, and Tc_2Al_3. The phase $TcAl_{12}$ has a b.c.c. structure with a =7.5270 ± 0.0003A and is isostructural with WAl_{12}. $TcAl_4$ is monoclinic with cell dimensions a = 5.1, b = 17.0, c = 5.-A (all ± 0.1A) and β = 100° ± 1°. Tc_2Al_3 is trigonal with a = 4.16, c = 5.13A (both ± 0.01A). This phase is thought to have the Ni_2Al_3 structure, the change in unit cell volume being consistent with the atomic volumes of Tc and Ni. The refinement of the structure of the phases $TcAl_{12}$ and $TcAl_4$ is now being undertaken.

417

Cambridge U. Cavendish Lab. (Gt. Brit.).

AN INVESTIGATION OF THE ORDERING OF THE PHASES CoAl AND NiAl, by M. J. Cooper. [1963] 6p. incl. diagrs. (AFOSR-J694) (AF EOAR-61-24) AD 414170   Unclassified

Also published in Philos. Magazine, v. 8: 805-810, May 1963.

An investigation of the variation of lattice parameter with composition over a small range of composition for the phases CoAl and NiAl has confirmed that a peak value occurs and has enabled the corresponding phase-composition to be determined. For CoAl this is close to the ideal 50-50% (atomic) composition, but in the case of NiAl the nickel sites are found to tolerate up to about 1.5% aluminum. The electron to unit cell ratios corresponding to these compositions are 3.00 and 3.04 for CoAl and NiAl respectively.

418

Cambridge U. Cavendish Lab. (Gt. Brit.).

A STUDY, BY X-RAY METHODS, OF ELECTRON DISTRIBUTION IN METALS AND ALLOYS, by W. H. Taylor. Final technical rept. July 31, 1963 [22]p. incl. tables, refs. (AFOSR-J1358) (AF EOAR-61-24) AD 427994   Unclassified

Absolute measurements have been made of x-ray scattering from Cr, CoAl and NiAl. To a first approximation the scattering corresponds to that from ground-state free atoms; the small differences observed are discussed, particularly in relation to other published measurements. The powder techniques used for the above measurements are to be supplemented by the use of single-crystal methods. The necessary preliminary experiments are in progress. The examination of alloy systems and the analysis of the structures of alloy phases have been continued. These include the Al-Fe, Al-Mo, Al-Re, Al-Tc and Co-Mo systems. Interesting generalizations about the nature of the interatomic bonds, and new information about the phase diagrams, have emerged from these studies. (Contractor's abstract)

419

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE PHASE DIAGRAM OF THE ALUMINUM-MOLYBDENUM SYSTEM, by L. K. Walford. [1963] [4]p. (AFOSR-64-2118) (AF EOAR-61-24) AD 451706   Unclassified

Also published in Philos. Magazine, v. 9: 513-516, Mar. 1964.

Some changes to the aluminum-rich end of the Al-Mo phase diagram are proposed. The results of several workers indicate that two new phases ($MoAl_4$ and $MoAl_{16}$) have to be introduced and that one phase ($MoAl_2$) should be omitted from the existing diagram. (Contractor's abstract)

420

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE REFINEMENT OF THE CRYSTAL STRUCTURE OF THE INTERMETALLIC PHASE Al_4Mo, by J. A. Leake. Aug, 19, 1963, 7p. (AFOSR-64-2119) (AF EOAR-61-24) AD 451707   Unclassified

Also published in Acta Cryst., v. 17: 918-924, July 1964.

The crystal structure of Al_4Mo has been refined by means of two-dimensional difference syntheses using visually estimated x-ray intensity data. The space group is Cm. The unit cell has lattice parameters a = 5.255, b = 17.768, c = 5.225A, and β = 100° 53 min and contains 30 atoms arranged in sets of almost close-packed puckered planes. Isomorphism with Al_4W is confirmed. (Contractor's abstract)

421

Cambridge U. Cavendish Lab. (Gt. Brit.).

THEORY OF INITIATION OF EXPLOSION IN SOLIDS
BY AN INTENSE LIGHT FLASH, by T. Boddington.
Nov. 1963, 62p. (AFOSR-64-2015) (AF EOAR-64-18)
AD 619542   Unclassified

The evolution of the temperature profile within a solid
capable of exothermic decomposition is derived from
an approximate analytic solution of the equation desc..b-
ing heat conduction in the presence of continuously
distributed heat sources due to chemical decomposition
and to the absorption of an intense, short duration pulse
of light. The critical light intensity capable of giving
rise to a thermal explosion is deduced and a minimum
critical intensity is shown to exist. The model predicts
all the major experimental features of ignition by light.
(Contractor's abstract)

422

Cambridge U. Cavendish Lab. (Gt. Brit.).

GROWTH OF BURNING TO DETONATION IN LIQUIDS
AND SOLIDS, by F. P. Bowden. Dec. 1964, 6p.
(Rept. no. 1) (AFOSR-65-0696) (AF EOAR-64-18)
AD 640139   Unclassified

Explosion in nitroglycerine by impact was recorded
using a high-speed C_4 framing camera. The introduc-
tion of inhomogeneities favors the formation of localized
concentrations of energy in the form of hot spots, at
which chemical reaction can be initiated. In the early
stages the chemical reaction propagates as an acceler-
ating fast burning at up to several hundred of metres
per second. It appears that certain conditions (e.g.,
turbulence, and the formation of a mixture of liquid
droplets, unreacted nitroglycerine vapor and hot gase-
ous products) are essential for subsequent transition
from this regime to a more violent explosion. The
study of fracture propagation was concentrated on single
crystals of magnesium oxide, using high-speed photog-
raphy (Beckman and Whitley) and independently an ultra-
sonic method. High-speed photographic records using
a Beckman and Whitley camera were made of the de-
flagration and detonation of single crystals of PETN,
RDX, HMX, and silver azide. New theories of initia-
tion of explosion by light and of the growth and decay
of hot-spots in condensed explosives were developed.

423

Cambridge U. [Dept. of Applied Mathematics and
Theoretical Physics] (Gt. Brit.).

REGGE POLES AND BRANCH CUTS FOR POTENTIAL
SCATTERING, by J. Challifour and R. J. Eden.
Sept. 12, 1962, 13p. (AFOSR-64-0367) (AF EOAR-
63-79) AD 434526   Unclassified

Also published in Jour. Math. Phys., v. 4: 359-371,
Mar. 1963.

The analytic properties of partial wave amplitudes are
studied for complex energy and angular momentum.
The properties of the wavefunctions are first obtained
by standard method in the theory of differential equa-
tions for general classes of potentials, and the effects
of the dominant singular term in the potential near the
origin are investigated. These include the appearance
of branch cuts in the angular-momentum variable for
potentials which are singular like z^{-2}, and the location
of Regge pole for more singular potentials. The trajec-
tories of Regge poles are also studied with particular
reference to their behavior in the angular-momentum
plane as the energy tends to infinity. An example is
given of a singular potential in which the trajectories
move to infinity in a complex direction, contrary to the
normal behavior for which they tend to negative integers.
The real sections of Regge surfaces are also briefly
discussed. (Contractor's abstract)

424

Cambridge U. Dept. of Applied Mathematics and
Theoretical Physics (Gt. Brit.).

SINGULARITY OF THE REGGE AMPLITUDE, by J. N.
Islam, P. V. Landshoff, and J. C. Taylor. [1963]
[6]p. incl. diagrs. refs. (AFOSR-64-0368) (AF EOAR-
63-79) AD 434524   Unclassified

Also published in Phys. Rev., v. 130: 2560-2565,
June 15, 1963.

It is shown that the Regge amplitude a(1, s) has singulari-
ties at certain fixed, real, physical values of s for all
nonphysical values of 1. These singularities are not
normal thresholds and are not singularities of the com-
plete amplitude A(s, t, u). They arise indirectly through
unitarity. Their presence is deduced from the existence
of a perturbation graph which satisfies the Mandelstam
representation with spectral boundary curves having
asymptotes other than the normal threshold lines.
(Contractor's abstract)

425

Cambridge U. [Dept. of Applied Mathematics and
Theoretical Physics] (Gt. Brit.).

SINGULARITIES OF FEYNMAN AMPLITUDES, by I.
T. Drummond. Feb. 22, 1963, 22p. (AFOSR-64-0370)
(AF EOAR-63-79) AD 434537   Unclassified

Also published in Nuovo Cimento, Series X, v. 29:
720-741, Aug. 10, 1963.

The analytic properties of perturbation theory amplitudes
written as integrals over internal invariants are dis-
cussed. Single-loop amplitudes are considered and a
condition, equivalent to the positive alpha condition, is
derived for singularity in the physical limit. Some
simple double-loop diagrams are discussed also and the
existence and nature of a certain mixed second-type
singularity is investigated. A feature of these latter
diagrams is the necessity of dealing with spurious singu-
larities. The relevance of these considerations to cer-
tain 3-particle phase-space integrals is pointed out.
(Contractor's abstract)

426

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

HIGH-ENERGY BEHAVIOR IN PERTURBATION THEORY. II, by J. C. Polkinghorne. May 20, 1963, 5p. (AFOSR-64-0522) (AF EOAR-63-79) AD 436377
Unclassified

Also published in Jour. Math. Phys., v. 4: 1396-1400, Nov. 1963.

Contributions to the asymptotic behavior of Feynman integrals are evaluated which correspond to pinches in the interior of the hypercontour of integration. It is shown that they give the Gribov-Pomeranchuk phenomenon and Regge cuts. A set of diagrams is investigated which gives a Regge cut on the physical sheet. (Contractor's abstract)

427

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

SINGULARITIES OF REGGE TRAJECTORIES AND ASYMPTOTES TO LANDAU CURVES, by J. C. Polkinghorne. [1963] [3]p. (AFOSR-64-0638) (AF EOAR-63-79) AD 435940   Unclassified

Also published in Jour. Math. Phys., v. 4: 1393-1395, Nov. 1963.

A new class of singularities associated with the trajectories and residues of particular Regge poles is investigated. It is shown that the singularities are associated with properties of asymptotes to Landau curves. One of the singularities corresponds to the singularity of the Regge amplitude discovered recently by Islam, Landshoff, and Taylor. The only singularities affecting physical asymptotic behavior correspond to diagrams which have all three Mandelstam spectral functions. (Contractor's abstract)

428

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

DISPERSION THEORY AND THE NUCLEAR MANY-BODY PROBLEM, by R. J. Eden and J. Goldstone. [1963] [11]p. (AFOSR-64-0658) (AF EOAR-63-79) AD 435924   Unclassified

Also published in Nuclear Phys., v. 49: 33-43, 1963.

The equations of the nuclear many-body problem are formulated so that the analyticity properties required by dispersion theory are retained in each approximation. In particular the vertex parts for photon or nucleon absorption by a nucleus will have the analyticity expected from dispersion theory provided the nucleon-nucleon interaction has the usual analytic properties. By summation of diagrams in relativistic dispersion theory a closed scheme of self-consistent equations is

obtained for vertex parts involving a nucleus. The non-relativistic approximations are described, which relate this scheme to the usual self-consistent equations for nuclear wave functions. (Contractor's abstract)

429

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

SEPARABLE NONLOCAL POTENTIALS AND REGGE POLES, by M. McMillan. Mar. 11, 1963, 8p. (AFOSR-64-0659) (AF EOAR-63-79) AD 435936
Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 1043-1050, Sept. 1, 1963.

Partial wave amplitudes and Regge poles for nonrelativistic two-body scattering via a separable nonlocal potential are studied. The Schrödinger equation is solved exactly and the partial wave amplitudes are written in a simple closed form valid for any potential satisfying certain minor restrictions at the origin and at infinity. Many previously known properties of amplitudes and Regge poles appear rather simply here. (Contractor's abstract)

430

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

LEADING LANDAU CURVES OF SOME FEYNMAN DIAGRAMS, by J. N. Islam. [1963] [7]p. incl. diagrs. (AFOSR-64-0660) (AF EOAR-63-79) AD 435925
Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 259-265, Oct. 1, 1963.

It is shown that the leading Landau curves of some Feynman diagrams possess no parts associated with positive Feynman parameters when some of the external and internal masses satisfy certain inequalities. The assumed validity of Mandelstam representation then implies that the corresponding leading curves are nonsingular on the physical sheet. (Contractor's abstract)

431

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

POLES AND SHADOW POLES IN THE MANY-CHANNEL S MATRIX, by R. J. Eden and J. R. Taylor. Nov. 7, 1963, 6p. (AFOSR-64-1150) (AF EOAR-63-79) AD 442843   Unclassified

Also published in Phys. Rev., v. 133: B1575-B1580, Mar. 23, 1964.

The connection between the partial-wave S matrix on different Riemann sheets is obtained from unitarity and analyticity. Under the assumption that coupling between

channels can be varied analytically, it is shown that a resonance pole or bound-state pole may lead also to "shadow poles" on other Riemann sheets. The existence of shadow poles is illustrated by a unitary resonance model based on a sum of Feynman diagrams. In general, the number of shadow poles that can be deduced from an observed resonance depends on the number of channels that still have a particular resonance pole in the absence of coupling between channels. If the pole still appears in all channels, then shadow poles occur on every Riemann sheet; if it appears in only one channel, then shadow poles appear on half the sheets. If the resonance disappears in the absence of channel coupling, our method leads to no conclusions. In connection with the unitary symmetry scheme it is noted that the existence of shadow poles would permit a simple changeover from the separated poles of a resonance multiplet with broken symmetry to the coincident poles of the multiplet that must occur when the symmetry breaking interaction is switched off. (Contractor's abstract)

432

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

THE COMPLETE HIGH-ENERGY BEHAVIOR OF LADDER DIAGRAMS IN PERTURBATION THEORY, by J. C. Polkinghorne. [1964] [4]p. incl. diagrs. (AFOSR-64-1760) (AF EOAR-63-79) AD 449060
Unclassified

Also published in Jour. Math. Phys., v. 5: 431-434, Mar. 1964.

The Mellin-transform method for obtaining the high-energy behavior of Feynman integrals is modified and applied to the set of ladder diagrams. The complete set of terms of the form $s^{-1}(\ln s)^n$ is summed, and gives an equation for the trajectory function which is analogous to that obtained by Fredholm methods for a Yukawa potential. A perturbation expansion for $\alpha(t)$ valid for t large is given, and the threshold behavior investigated. The results confirm the reliability of the perturbation-theory method of investigations. They also exhibit directly the connection between high-energy behavior and the poles of the scattering amplitude. (Contractor's abstract)

433

[Cambridge U.] Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

MAJORIZATION OF FEYNMAN DIAGRAMS INVOLVING PIONS AND NUCLEONS, by J. B. Boyling. [1964] [31]p. incl. diagrs. refs. (AFOSR-64-2336) (AF EOAR-63-79) AD 451925
Unclassified

Also published in Ann. Phys., v. 28: 435-465, 1964.

A method used previously for the majorization of Feynman diagrams involving scalar mesons and conserved baryons is adapted to the case where the mesons are pseudoscalar. The Symanzik regions for certain

production amplitudes are found, and some support properties proved for the weight functions in Nakanishi's integral representations for scattering and one-particle-production amplitudes.

434

[Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).]

ON THE FIELD EQUATIONS, by J. G. Taylor. [1963] [179]p. incl. refs. (AFOSR-65-0119) (AF EOAR-63-79) AD 455731
Unclassified

Also published in Nuovo Cimento, Series I, Suppl., v. 1: 857-1035, 1963.

In a collection of six closely connected papers, a field theory approach to elementary particles is attempted which is to avoid the pitfalls of high-energy divergences. The canonical equations arising from local field equations are obtained and generalized beyond local field equations. This results in unitarity off the mass shell, which is called complete unitarity. To avoid the problems of high-energy divergences, a suitable finite number of differentiations is made of the complete unitarity equations in the external moments. This is only possible for the renormalizable interactions, in the perturbation sense. The high-energy divergences of weak interactions are discussed outside perturbation theory. For the renormalizable interactions an attempt is made to compute physical quantities from the complete unitarity equations. To do this, various physically reasonable approximation schemes are discussed. To set up the resonance approximation, resonances and composite particles are exposed. The goals of the investigation are partially obtained.

435

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

HIGH-ENERGY BEHAVIOUR OF FEYNMAN INTEGRALS INVOLVING SINGULAR CONFIGURATIONS, by M. M. Menke. [1964] [20]p. incl. diagrs. (AFOSR-65-0120) (AF EOAR-63-79) AD 455732
Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 351-370, Oct. 16, 1964.

The high-energy asymptotic behavior of Feynman diagrams containing certain singular configurations is investigated. The leading contributions are factorized and summed to give Regge-pole terms. A new feature of the discussion is that it is sometimes necessary to scale disconnected sets of lines in addition to the usual connected sets.

436

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

TIME AND THE S MATRIX, by D. Branson. [1964]

[8]p. incl. diagrs. (AFOSR-65-0121) (AF EOAR-63-79) AD 455939   Unclassified

Also published in Phys. Rev., v. 135: B1255-B1262, Sept. 7, 1964.

A method is introduced for defining the time duration of a scattering process. Using this definition, the connection between causality and analyticity is discussed. An application to 3-particle scattering leads to a discussion of the necessity for the existence of stable and unstable particle poles, and finally an analysis is given of rescattering processes and the generation of 2-particle normal thresholds, with a view to obtaining Feynman's i^ϵ prescription for deciding which is the physical boundary value.

437

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

HERMITIAN ANALYTICITY AND EXTENDED UNITARITY IN S-MATRIX THEORY, by J. B. Boyling. [1964] [18]p. incl. diagrs. refs. (AFOSR-65-0122) (AF EOAR-63-79) AD 455730   Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1356-1373, Sept. 1, 1964.

It is shown that the apparent contradiction between Olive's method of proof of hermitian analyticity and the existence of anomalous thresholds disappears on a closer examination of the singularity structure of multiparticle amplitudes. By making use of the hierarchy property of the Stapp-Polkinghorne singularity structure implied by maximal analyticity, hermitian analyticity and extended unitarity are proved for a scattering amplitude exhibiting anomalous threshold behavior and for an equal-mass production amplitude.

438

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

HIGHER ORDER POLES IN THE S MATRIX, by R. J. Eden and P. V. Landshoff. [1964] [4]p. incl. diagr. (AFOSR-65-0832) (AF EOAR-63-79) AD 616468   Unclassified

Also published in Phys. Rev., v. 136: B1817-B1820, Dec. 1964.

A method is developed for studying the possibility of a coincidence of more than one complex pole of the S matrix so as to produce a higher order pole. It is shown thereby that complex higher order poles may be consistent with generalized unitarity, although a real higher order pole is not consistent with physical unitarity. Also discussed is the relevance of higher order poles, and of a group of simple poles, to the Wigner time-decay formula.

439

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

ASYMPTOTIC BEHAVIOR OF FEYNMAN INTEGRALS WITH SPIN, by J. C. Polkinghorne. [1964] [8]p. incl. diagrs. (AFOSR-65-0833) (AF EOAR-63-79) AD 616452   Unclassified

Also published in Jour. Math. Phys., v. 5: 1491-1498, Nov. 1964.

Some general features are investigated of the dependence of the asymptotic behavior of Feynman integrals upon factors in the numerator of the integrand resulting from particles with spin. These results are used to analyze the high-energy behavior of ladder diagrams for spin-1/2 nucleons interacting with neutral vector mesons. The leading contribution is shown to consist of terms corresponding to a reggeized nucleon together with certain other terms. The expected cancellation of these other terms by terms associated with a well-defined class of crossed diagrams is verified in detail for the sixth-order case. Finally, other significant diagrams, different from the ladders and their associated crossed diagrams, are investigated and it is shown that they only provide higher-order corrections to the trajectory of the reggeized nucleon.

440

[Cambridge U.] Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

UNITARITY, HERMITICITY AND DISCONTINUITY RELATIONS, by J. R. Taylor. [1964] [13]p. (AFOSR-65-0144) (AF EOAR-64-79) AD 455733   Unclassified

Also published in Nuclear Phys., v. 58: 580-592, 1964.

The relationship between unitarity, hermitian-analyticity and the discontinuity relations for the T matrix is discussed. The generalized discontinuity relations, sometimes called generalized unitarity, are examined and their theoretical status discussed. It is shown that symmetry of the T matrix has no relevance to these properties. Finally, all these properties are proved in the framework of the multichannel Schrödinger theory. It is shown that in Schrödinger theory the discontinuity relations arise naturally from the definition of the S matrix in terms of ingoing and outgoing waves and that unitarity and hermitian analyticity hold when the potential matrix is hermitian. (Contractor's abstract)

441

Cambridge U. [Psychological Lab.] (Gt. Brit.).

A PERIMETRIC STUDY OF VISUAL FIELD DEFECTS IN MONKEYS, by A. Cowey and L. Weiskrantz. 1963, 25p. (AFOSR-64-1295) (AF 61(052)185) AD 444264   Unclassified

Also published in Quart. Jour. Exper. Psychol., v. 15: 91-115, June 1963.

The visual fields of rhesus monkeys have been studied perimetrically before and after removal of parts of the striate cortex. The operations produced visual defects of the expected size, shape, and position but an animal's ability to respond to a flash of light which appeared in the defective part of the field was diminished rather than abolished. It is suggested that this residual ability enables an animal to detect changes in illumination, which might be cues to other visual events. A study of fixation indicates that the animals probably do not recognize or respond to objects when they lie within the impaired region of the visual field. The results are compared with those found in earlier studies of simian and human subjects. (Contractor's abstract)

442

Cambridge U. [Psychological Lab.] (Gt. Brit.).

THE BASE OF A METHOD OF PERIMETRY WITH MONKEYS, by A. Cowey. 1963, 12p. (AFOSR-64-1296) (AF 61(052)185) AD 444263   Unclassified

Also published in Quart. Jour. Exper. Psychol., v. 15: 81-90, May 1963.

The value of perimetry as a means of studying the visual system is stressed. Perimetry has never been done with animals because it is difficult to record and control their fixation. Existing methods of determining eye position cannot readily be used with monkeys, chiefly because the subject's head must be prevented from moving more than fractions of an mm. Other limitations are mentioned. A new method of determining fixation is described. Although not nearly as precise as other methods, it is unaffected by head movements as great as 1/2 in. It is straightforward to restrict a monkey's head movements to this amount. The eye position is found from the relative positions of four corneal reflections and the borders of the iris. These relative positions change very much more after an eye rotation than they do after a head movement in which fixation has been maintained. (Contractor's abstract)

443

Cambridge U. [Psychological Lab.] (Gt. Brit.).

STRIATE CORTEX LESIONS AND VISUAL ACUITY OF THE RHESUS MONKEY, by L. Weiskrantz and A. Cowey. Mar. 23, 1962, 7p. (AFOSR-64-1297) (AF 61(052)185) AD 444262   Unclassified

Also published in Jour. Compar. Physiol. Psychol., v. 56: 225-231, 1963.

Visual acuity was measured pre- and postoperatively in monkeys given resections of striate or inferotemporal cortex. Striate Ss showed decreases in acuity, the severity of which corresponded reasonably well with the completeness and location of the lesions. Temporal Ss showed no decrease. The drop in acuity shown by the striate Ss was less than would be predicted if the lesion produced an absolute scotoma and if the relation between foveal and parafoveal acuity is the same in monkey as in man.

444

Cambridge U. [Psychological Lab.] (Gt. Brit.).

LOCOMOTOR ACTIVITY FOLLOWING LATERAL FRONTAL LESIONS IN RHESUS MONKEYS, by C. G. Cross. Mar. 21, 1962, 125p. (AFOSR-64-1298) (AF 61(052)185) AD 444261   Unclassified

Also published in Jour. Compar. Physiol. Psychol., v. 56: 232-236, 1963.

Effects of bilateral frontal lesions on locomotor activity were studied under various stimulus conditions. Eight monkeys were tested after, and 13 monkeys before and after, partial ablation of lateral frontal granular cortex or as unoperated controls. Ss with lesions that included sulcus principalis were hyperreactive to light. Their locomotor activity in light as well as darkness was more enhanced by relatively familiar auditory stimuli, and more depressed by relatively novel stimuli than that of unoperated Ss, or of Ss with lateral frontal lesions which spared sulcus principalis. (Contractor's abstract)

445

Cambridge U. [Psychological Lab.] (Gt. Brit.).

THE AETIOLOGY OF FOOD REWARD IN MONKEYS, by L. Weiskrantz and A. Cowey. Sept. 1, 1962, 10p. (Rept. no. RN 328) (AFOSR-64-1299) (AF 61(052)185) AD 444256   Unclassified

Also published in Animal Behavior, v. 11: 225-234, Apr.-July 1963.

The response of rhesus monkeys to new foods was measured in two ways: by measuring the amount of food consumed on repeated exposure, and the latency of an instrumental response made with respect to the food. The following results were obtained: Using the consumption measure, the amount of food consumed may be quite small on the first few days and then rise to a large value after a period of weeks. The visual experience of the animal in watching other animals consume the food can be important in determining whether it will subsequently accept the food. It is possible to convert a nonconsumer into a consumer by arranging for such visual experience to take place. Mere passage of time does not appear to be sufficient in reversing an initial rejection of a food, or an acquired acceptance of a food. (Contractor's abstract)

446

Cambridge U. [Psychological Lab.] (Gt. Brit.).

CONTOUR DISCRIMINATION IN A YOUNG MONKEY WITH STRIATE CORTEX ABLATION, by L. Weiskrantz. Jan. 18, 1963, 20p. (AFOSR-64-1160) (AF EOAR-62-20) AD 442839   Unclassified

Also published in Neuropsychol., v. 1: 145-164, 1963.

A young (4½ mo old) rhesus monkey was subjected to bilateral removal of striate cortex. No striate cortex

remained in post-mortem examination, but a small cluster of undegenerated call was found in each antero-ventral lateral qeniculate nucleus. A series of 11 experiments, involving various types of visual discriminations, is described

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Cambridge U. Psychological Lab. (Gt. Brit.).

STUDIES OF: (A) THE VISUAL FIELDS OF MONKEYS. (B) MEMORY PROCESSES AS AFFECTED BY CERE-BRAL LESIONS IN MONKEYS, by L. Weiskrantz. Final technical rept. Nov. 30, 1963 [25]p. (AFOSR-64-0332) (AF EOAR-63-34) AD 438389 Unclassified

Analysis of the visual cortex and its relation to behavior, and of the changes in mnemonic function following circumscribed cerebral lesions and stimulation in the monkey is reported. Previous research has shown that changes in visual capacity following striate cortex lesions in the monkey are not absolute. When assessed by a perimetry device, the defective regions of the visual fields still permit a response to brief, dim flashes of light, although with decreased efficiency. Acuity measurements indicate a drop in acuity less than that predictable from the supposed distance of the edge of the field defect from the fovea. It is suggested that the residual capacity is simply the integral of the types of responses found from retinal ganglion cells. Memory changes were analyzed in terms of a distinction between short-term and long-term processes. (Contractor's abstract)

448

Cambridge U. [Psychological Lab.] (Gt. Brit.).

THE CURIOUS EYE OF COPILIA, by R. L. Gregory, II. E. Ross, and N. Moray. 1964, 4p. (AFOSR-64-1308) (AF EOAR-63-93) AD 444258 Unclassified

Also published in Nature, v. 201: 1166-1168, Mar. 21, 1964.

Nine living specimens of Copilia were examined. Exner's description was found to be accurate with regard to the female specimens, the males being very different. Using high-quality optical microscopes (bright-ground, dark-ground and phase contrast Leitz equipment) we found that the internal structure, muscles, ligaments and the nervous system could easily be observed in the living unstained specimen. In particular, the oscillatory movement of the posterior lens and receptor, as reported by Exner, was readily observable. (Contractor's abstract)

449

Cambridge U. [Sub-Dept. of Veterinary Anatomy] (Gt. Brit.).

UNIT ACTIVITY IN THE HYPOTHALAMUS, by B. A. Cross and I. A. Silver. Final technical rept. Jan. 31, 1963, 14p. (AF 61(052)301) AD 632507 Unclassified

A study of over 800 units in the hypothalamus and other foreorain areas of more than a hundred animals has confirmed and extended earlier observations on the characteristics of hypothalamic unit activity. The majority of recorded hypothalamic neurones had spontaneous rates of firing in the range of 1-10/sec, and exhibited a more regular pattern of firing than neurones in the cortex or thalamus. The responses of hypothalamic neurones revealed a marked degree of sensory convergence. Usually two or more sensory stimuli excited the same neurone, but inhibitory interactions between differing sensory modalities were also observed. There was little evidence that neurones having particular patterns of activity or responsiveness were situated exclusively in localized areas. Fast unresponsive neurones were common in the subthalamus but also occurred in the ventral thalamus and hypothalamus. Neurones firing in short rapid bursts were found commonly in the thalamus and occasionally in the hypothalamus. Adjacent neurones frequently showed dissimilar behavior. Hypoxia, hypercapnia and hypoglycaemia had a predominantly excitatory effect on neurones in the posterior and lateral hypothalamic areas, associated with augmented sympathetico-adrenal activity. (Contractor's abstract)

450

Cambridge U. [Sub-Dept. of Veterinary Anatomy] (Gt. Brit.).

THE EFFECT OF OVARIAN HORMONES ON THE ACTIVITY OF HYPOTHALAMIC NEURONES, by B. A. Cross and I. A. Silver. Final technical rept. Apr. 24, 1964, 14p. (AFOSR-64-0986) (AF EOAR-62-47) AD 600381   Unclassified

Unit activity in the diencephalon of adult female rats under light urethane anaesthesia was recorded with steel microelectrodes and a polygraphic recording system. The responsiveness of neurones to pain and cold stimuli on the tail and mechanical probing of the cervix was examined. In dioestrous rats, injection of 1 or 10 μg of oestradiol intramuscularly increased the incidence of inhibitory effects of the standard stimuli in hypothalamic neurones while 1 μg of oestradiol produced no change. In a group of pseudopregnant rats, hypothalamic neurones showed a markedly depressed responsiveness to cervical probing similar to that previously observed in cyclic rats following injected progesterone. No corresponding hormonally induced changes in responsiveness were observed in thalamic neurones. (Contractor's abstract)

451

Cambridge U. Dept. of Zoology (Gt. Brit.).

MECHANISMS OF INTEGRATION OF PATTERNS OF BEHAVIOR: A. STUDY OF THE DEVELOPMENT AND INTEGRATION OF NEST BUILDING SKILLS IN CANARIES. B. CHANGES IN RESPONSIVENESS UNDER CONSTANT OR REPETITIVE STIMULATION. C. THE EFFECT OF AUDITORY DEPRIVATION OF BEHAVIOUR, by R. A. Hinde. Final technical rept. Jan. 31, 1964, 5p. (AFOSR-64-0736) (AF EOAR-63-26) AD 438238   Unclassified

The role of changes in tactile sensitivity of the brood patch in the integration of nestbuilding behavior of female canaries has been studied. This has involved work on the hormonal control of brood-patch development, including injection of steroids into normal and ovariectomized birds. Experiments have also been conducted on the induction of reproduction behavior in winter. The changes in reproductive behavior are being correlated with changes in ovarian histology. The moment to moment changes in strength of the mobbing response shown by chaffinches to owls is being analyzed and some of the underlying processes isolated. Techniques for the experimental deafening of birds have been investigated. (Contractor's abstract)

452

Canterbury U. [Dept. of Chemistry] Christchurch (New Zealand).

PHOTOMETRIC STUDY OF THE REACTION OF IODINE WITH ACTIVE NITROGEN, by C. G. Freeman and L. F. Phillips. [1964] [6]p. (AFOSR-64-1518) (AF AFOSR-63-264) AD 446348   Unclassified

Also published in Jour. Phys. Chem., v. 68: 362-367, Feb. 1964.

Photometric observations have been made on the flame produced when iodine vapor is mixed with active nitrogen from a microwave discharge. A mechanism of 7 reactions is proposed for the overall reaction. The rate constants for two of the reactions are given. The most conspicuous feature of the reaction flame is intense emission in the blue and ultraviolet, arising from reactions 5 and 6. Pink emission from the point of mixing is mainly due to reaction 7. The reaction is suggested as a means of producing energetic species of nitrogen molecules in order to study their behavior in the absence of nitrogen atoms. (Contractor's abstract)

453

Canterbury U. Dept. of Chemistry, Christchurch (New Zealand).

PHOTOMETRIC OBSERVATIONS ON THE REACTIONS OF ACTIVE NITROGEN WITH CHLORINE AND BROMINE, by K. S. Raxworthy and L. F. Phillips. [1964] [3]p. incl. refs. (AFOSR-65-0886) (AF AFOSR-63-264) AD 617237   Unclassified

Also published in Canad. Jour. Chem., v. 42: 2928-2930, 1964.

The results of reactions of chlorine and bromine with active nitrogen, with production of metastable $A(^3\Sigma_u^+)$ nitrogen species, are presented. The chlorine reaction produces almost no emission other than a weak nitrogen afterglow. The bromine reaction, however, produces a bright orange NBr emission. Excited halogen molecules reacted in both cases to produce a very weak emission, which decayed in a manner similar to the decay of the weak nitrogen afterglow. These results

are contrasted with iodine, which in the excited state produces intense emission in the blue and ultraviolet wavelengths.

454

Carnegie Inst. of Tech. [Dept. of Chemistry] Pittsburgh, Pa.

A SEARCH FOR HOT RADICAL REACTIONS IN FLASH PHOTOLYSIS, by G. J. Mains. Final rept. Nov. 30, 1963, 54p. (AFOSR-J1521) (AF AFOSR-62-51) AD 429260   Unclassified

Flash photolysis of diethyl ketone produced carbon monoxide, butane, ethylene, ethane, propane, propion-aldehyde, hydrogen and methyl ethyl ketone as products of decreasing importance. The observation of diethyl ketone-d_5 among the flash photolysis products of a mixture of diethyl ketone and diethyl ketone-d_{10} confirmed the importance of the propionyl radical at 24°C and its temperature dependence. While most of the products were explainable in terms of the low intensity photolysis mechanism, it was necessary to postulate reactions of vibrationally hot species to explain the production of hydrogen, propane, methyl ethyl ketone and the large relative yield of ethylene. Observed products from flash photolysis of diethyl mercury at room temperature were butane, ethylene, ethane, propane and hydrogen in decreasing importance. The reaction products from the ethyl mercury radical were not observed. Because of the relatively high yield of ethylene it was necessary to invoke mechanisms involving reactions of hot ethyl radicals including unimolecular decomposition and disproportionation reactions. (Contractor's abstract)

455

Carnegie Inst. of Tech. [Dept. of Chemistry] Pittsburgh, Pa.

THE TEMPERATURE DEPENDENCE OF THE FLASH PHOTOLYSIS OF DIETHYL KETONE, by L. C. Fischer and G. J. Mains. [1964] 9p. incl. diagrs. tables, refs. (AFOSR-64-0298) (AF AFOSR-64-513) AD 434520   Unclassified

Also published in Jour. Phys. Chem., v. 68: 188-196, 1964.

The flash photolysis of diethyl ketone yielded carbon monoxide, butane, ethylene, ethane, propane, and hydrogen as gaseous products of decreasing importance. Propionaldehyde and methyl ethyl ketone were found among the liquid products. The observation of diethyl ketone-d_5 among the flash photolysis products of a mixture of diethyl ketone and diethyl ketone-d_{10} confirmed the importance of the propionyl radical at 24° and its temperature dependence. While most of the products were explainable in terms of the low intensity photolysis mechanism, it was necessary to postulate reactions of vibrationally "hot" species to explain the production of hydrogen, propane, and methyl ethyl ketone and the large yield of ethylene. Tentative values of 0.4 ± 0.1

and 0.15 ± 0.1 were assigned to the disproportion—re-
combination ratio of ethyl and proptonyl radicals into
ethylene and proptonaledhyde and ethane and methyl
ketene, respectively.

456

Carnegie Inst. of Tech. [Dept. of Chemtstry]
Pittsburgh, Pa.

THE FLASH PHOTOLYSIS OF MERCURY DIETHYL,
by L. C. Fischer and G. J. Mains. [1964] 7p. (AFOSR-
64-2505) (AF AFOSR-64-513) AD 453823
Unclassified

Also published tn Jour. Phys. Chem., v. 68: 2522-
2528, 1964.

The observed products from the flash photolysis of
mercury diethyl at room temperature were butane,
ethylene, ethane, propane, and hydrogen tn decreastng
tmportance. Antictpated reaction products from the
ethylmercury radical were not observed, and good values
for a material balance were found. Because of the rela-
tively htgh yield of ethylene tt was necessary to tnvoke
mechanisms involving reactions of hot ethyl radicals
tncluding unimolecular decomposition and disproar-
tionation reactions, the latter resulting in the production
of methyl radicals. A detailed analysis of the C_2
products based on the assumed mechanism indicated that
about 10% of the ethylene may be attributed to the dis-
proportionation of hot ethyl radicals; untmolecular de-
composition of vibrationally excited ethyl radicals was
suggested to account for 40% of the ethylene formed.
(Contractor's abstract)

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Carnegie Inst. of Tech. [Dept. of Computer Sctence]
Pittsburgh, Pa.

A COMPUTER PROGRAM FOR DISCOVERING AND
PROVING SEQUENTIAL RECOGNITION RULES FOR
WELL-FORMED FORMULAS DEFINED BY A BACKUS
NORMAL FORM GRAMMAR, by R. L. London.
Intertm rept. May 1964, 88p. tncl. refs. (AFOSR-67-
0259) (SD-146)   Unclassifted

This report ts based upon a computer program which
will discover rules for the recognitton of grammatical
strings when given a simple Backus Normal Form gram-
mar. The program attempts to prove that these rules
are both necessary and sufftctent to charactertze gram-
matical strtngs. The matn mathematical techniques
that are mechantzed are tnduction and case analysis.
In addition the program ts capable of productng counter-
examples. Since the program ts wrtting proofs, several
(meta-) proofs are tncluded asserting the correctness
of the produced proofs.

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Carnegie Inst. of Tech. [Dept. of Computer Science]
Pittsburgh, Pa.

AN EXAMPLE OF HUMAN CHESS PLAY IN THE LIGHT
OF CHESS PLAYING PROGRAMS, by A. Newell and H.
A. Simon. Aug. 1964, 15p. incl. illus. diagrs. refs.
(AFOSR-67-0260) (SD-146) AD 619386   Unclassified

This paper trtes to show that a human's analysts of a
chess position can be understood in the same terms we
use for chess programs and other problem solvtng, t.
e., based on simple functions to oe performed. How-
ever, they are tn some cases more subtle than those
used tn present programs. And at htgher levels of
tntegration, the subject engages tn means-ends analysis,
working backward from a desired goal to set up a sub-
goal. These higher levels of organization are mtssing
from chess programs, although the general means-ends
analysis forms the basts of other problem solving
programs.

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Carnegie Inst. of Tech. [Dept. of Computer Science]
Ptttsburgh, Pa.

SCADS: A PROGRAMMING SYSTEM FOR THE
SIMULATION OF COMBINED ANALOG DIGITAL SYS-
TEMS, by J. C. Strauss and W. L. Gilbert. [1964]
[173]p. incl. refs. (AFOSR-67-2518) (SD-146)
Unclassifted

The SCADS system has been designed and implemented
on the Control Data G-20 computer tn order to facilttate
the process of "properly programmtng" the digital
computer to aid tn the solution of analog computer
oriented programs. The class of problems whtch are
solvable on an analog computer tncludes: (1) ordinary
differential equations with specifted inttial conditions;
(2) certain types of tntegral equations; (3) difference
equations with specified starting conditions; (4) com-
btned systems of integro-differential-difference equa-
tions, and (5) the stmulatton of physical systems which
can be charactertzed by equations of the above types.
In addition, there are well-known analog techntques for
obtatntng solutions to two-potnt boundary value problems
and to many two-variable partial differential equations.
It is probably safe to say that almost all problem formu-
lations and solution techntques commonly used tn con-
junction with analog computers can also be used tn
wrtting SCADS programs.

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Carnegie Inst. of Tech. [Dept. of Mathematics]
Ptttsburgh, Pa.

INTEGRAL REPRESENTATIONS OF AXIALLY SYM-
METRIC POTENTIAL FUNCTIONS, by A. E. Heins and
R. C. MacCamy. [1963] 15p. tncl. refs. (AFOSR-66-
2137) (AF AFOSR-64-647) AD 642975   Unclassifted

Also publtshed tn Arch. Rational Mech. and Anal.,
v. 13: 371-385, 1963.

This paper is concerned with solutions of elliptic partial differential equations in three variables when there is an axis of symmetry. The simplest example is Laplace's equation in x, y, and z. Solutions which are symmetric about the z-axis are then functions $u(r, z)$ of z and $r^2 = x^2 + y^2$, satisfying $L_k(u) = u_{rr} + k\,r^{-1}u_r + u_{zz} = 0$, $k = 1$.

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

DECAY OF 3.5-$MIN_{53}I^{122}$, by S. Jha. [1963] 5p. incl. diagrs. (AFOSR-64-0796) (AF AFOSR-63-278) AD 436479   Unclassified

Also published in Phys. Rev., v. 132: 2639-2643, Dec. 15, 1963.

Scintillation spectrometer studies of the radiations from I^{122} have shown 564-kev (100), 680-kev (7), 780-kev (5), 1250-kev (1.1), 1420-kev (0.9), 1750-kev (complex, 2), 2180-kev (1), 2540-kev (0.2), 2740-kev, 2920-kev, 3170-kev, and 3450-kev gamma rays with the intensities given in the parenthesis. From the gamma-gamma coincidence, positron-gamma coincidence, and the suming technique, it has been inferred that the 564-, 1250-, 1350 ± 10-, 1950 ± 30-, 2350 ± 50-, 2530 ± 50-, 2750 ± 50-, 2970 ± 50-, 3100 ± 50-, and 3400 ± 50-kev levels in Te^{122} are excited in the decay of I^{122}. From the gamma-gamma angular correlation studies the 1350-kev level is assigned the spin and parity 0^+. The log ft values of the positron decay to the ground, 564-, 1250-, 1340-kev states of Te^{122} have been estimated to be 4.6, 5.1, 6.2, and 6.2, respectively. The log ft value of the β^- decay of Sb^{122} to the 1350-kev state of Te^{122} has been estimated to be > 9.7. (Contractor's abstract)

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

DECAY OF 66-MIN $_{49}In^{110}$, by T. D. Nainan, A. S. Johnston, and S. Jha. [1964] 4p. incl. diagrs. table. (AFOSR-64-2059) (AF AFOSR-63-278) AD 452472   Unclassified

Also published in Phys. Rev., v. 135: B601-B604, Aug. 10, 1964.

A source of pure 66-min In^{110}, particularly free from 4.9-h In^{110m}, has been made by bombarding a natural indium foil with about 100-mev protons, and chemically separating tin (predominantly Sn^{110}, which is the parent of only 66-min In^{110} from the indium target. (Contractor's abstract)

463

Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

MÖSSBAUER EFFECT IN I^{127}, by F. De S. Barros,

N. Ivantchev and others. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-0488) (AF AFOSR-63-278) AD 613819
                Unclassified

Also published in Phys. Ltrs., v. 13: 142-144, Nov. 15, 1964.

The Mössbauer spectrum of the 59-kev γ-ray of I^{127} was obtained using a $ZnTe^{127m}$ source and a sodium paraperiodate ($Na_3H_2IO_6$) absorber, both at liquid hydrogen temperature. Several other iodine compounds were also tried as absorbers. The lower limit of the mean life of the 59-kev level was calculated from the width of the Mössbauer line and was compared with electronically measured values. The mean life is somewhat smaller than the measured values, partly due to incomplete crystallization of $ZnTe^{127m}$.

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Carnegie Inst. of Tech. Dept. of Physics, Pittsburgh, Pa.

EXCITED STATES OF IODINE-127, by S. Jha and R. Leonard. [1964] [6]p. incl. diagrs. table, refs. (AFOSR-65-0489) (AF AFOSR-63-278) AD 613823
                Unclassified

Also published in Phys. Rev., v. 136: B1585-B1590, Dec. 21, 1964.

The lifetime of the 59-kev first excited state of I^{127} has been measured using both xenon and tellurium parents. An average of the 2 results is 1.3 ± 0.3 msec. Angular correlation studies have also shown the multipolarity of the 59-kev γ-ray to be predominantly magnetic dipole with an electric quadrupole admixture of 0.6 ± 0.6%. Angular correlation studies have also been carried out on 2 other cascades of I^{127}: (1) The 175-200-kev cascade showed an anisotropy of 5 ± 3% when the Xe^{127} source was in the gaseous form, but when the source was adsorbed on charcoal an anisotropy of 30% was found. The smearing of the angular correlation is attributed to the highly ionized states of the γ-emitters resulting from electron capture; and (2) the 356-59-kev cascade exhibited an anisotropy of 0.498 ± 0.07 after geometric corrections. This permits assignment of the value 5/2 for the spin of the 415-kev state, while the 356 γ-ray is either 9.3 or 85% electric quadrupole, depending on which of the 2 possible solutions is selected. The lifetime of the 59-kev state after correction for internal conversion is longer by a factor 67 ± 14 than predicted by the Weisskopf estimate for an allowed magnetic dipole transition. This is consistent with the values observed for other 1-forbidden M1 transitions and with the most recent theoretical estimates.

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

LOG ft FOR ALLOWED INNER BETA GROUPS FROM ODD-ODD ISOTOPES, by S. Jha and A. S. Johnston. 1964 [3]p. incl. diagr. table. (AFOSR-65-0817) (AF AFOSR-63-278) AD 617861   Unclassified

Also published in Compt. Rend. Internat'l. Cong. Phys.

Nucleaire, Paris (France), July 2-8, 1964, Paris, CRNS, v. 2: 1183-1185, 1964.

By obtaining the spectrum of γ-rays associated only with the positron emission and if the spectrum is not complicated, it is possible to analyze the γ-ray spectrum and deduce from it the intensities of the positron feedings for the different levels. In order to exploit this possibility the positron emitting source was wrapped in a plastic cover thick enough to absorb all the positrons and was viewed by 2 NaI(Tl) crystal detectors, facing each other, to detect the 2 annihilation quanta in coincidence. A third NaI(Tl) crystal detector at right angles detected the γ-ray spectrum gave, on analysis, the relative positron branching ratios for the excited states. This method does not give the relative intensities of the positrons feeding the ground and the first excited states. This number had to be determined independently or had to be taken from the work of other investigators. In all sources investigated, the log ft for the allowed positron decay to the second excited state of the daughter nucleus is more or less hindered. Such a hindrance could be attributed to the forbiddenness of the creation of 2 phonons in the process of beta decay.

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

LOW-LYING LEVELS OF EVEN-EVEN XENON ISOTOPES, by S. Jha, A. S. Johnston and others. [1964] [2]p. incl. diagrs. (AFOSR-65-0819) (AF AFOSR-63-278) AD 617863   Unclassified

Also published in Compt. Rend. Cong. Internat'l. Phys. Nucleaire, Paris (France), July 2-8, 1964, Paris, CRNS, v. 2: 458-459, 1964.

The levels of xenon isotopes are investigated by studying the radiations from cesium and iodine isotopes. The levels of Xe^{126} were investigated by studying the radiations from 1.6 min Cs^{126} using an equilibrium mixture of 96 min Ba^{126} and Cs^{126}. The levels of Xe^{128} were investigated by studying the radiations from the equilibrium mixture of 2.4 day Ba^{128} and 3 min Cs^{128} and from 25 min I^{128}. Cs^{130} and I^{130} are also studied to indicate additional levels.

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Case Inst. of Tech. [Dept. of Chemistry] Cleveland, Ohio.

SOME GERMANIUM MACROCYCLIC COMPLEXES, by J. N. Esposito, L. E. Sutton, and M. E. Kenney. Aug. 6, 1964, 14p. (Technical rept. no. 1) (AF 49-(338)773) AD 604117   Unclassified

The macrocylic germanium complexes, $hpGeF_2$, $hpGeCl_2$, $hpGeBr_2$, $hpGe(OH)_2$, $(hpGeO)_x$, $hpGe(OC_4H_9-n)_2$, $hpGe(OC_6H_5)_2$, $PcGeF_2$, $PcGeBr_2$, and $PcGeI_2$ are reported together with additional data on hpH_2, $PcGeCl_2$ and $(PcGeO)_x$. A comparison is made of the low frequency infrared spectra of the oxy, hydroxy and

halo complexes. Evidence is given which indicates that $(hpGeO)_x$ is similar in structure to $(PcGeO)_x$. (Hp = hemiporphyrazine; Pc = phthalocyanine). (Contractor's abstract)

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Case Inst. of Tech. [Dept. of Mechanics] Cleveland, Ohio.

MELTING DECELERATING BODIES, by S. Ostrach. [1964] [25]p. incl. illus. diagrs. refs. (AFOSR-65-1156) (AF AFOSR-63-194) AD 620535   Unclassified

Also published in Nonlinear Problems of Engineering, New York, Academic Press Inc., 1964, p. 138-162.

An analysis is presented of the flow and heat transfer of a glassy viscous film of ablating material on the exterior surface of a body of revolution or a symmetric 2-dimensional body which enters the atmosphere at high speed and which experiences large deceleration and surface heating. The nonlinear problem associated with this type of ablation is considered. Results indicate that the ablation process can be theoretically described at the extremes in time, but more work is needed for intermediate times. An example is presented in which the ablative material is Pyrex.

469

Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

GALVANOMAGNETIC INVESTIGATION OF THE FERMI SURFACE OF MAGNESIUM, by R. W. Stark, T. G. Eck, and W. L. Gordon. [1964] 9p. (AFOSR-64-1236) (AF AFOSR-62-222) AD 442803   Unclassified

Also published in Phys. Rev., v. 133: A443-A451, Jan. 20, 1964.

The galvanomagnetic properties of several single-crystal specimens of magnesium have been investigated. The results of this investigation are presented and a Fermi surface topology consistent with the data is discussed. Many of the detailed features of the galvanomagnetic properties are found to result from the effects of magnetic breakdown. The magnetic breakdown associated with the "giant orbit" which Priestley observed in his pulsed-field de Haas-van Alphen study of magnesium is found to be complete for magnetic-field strengths of 5400 G. An open orbit whose net direction is parallel to the hexagonal axis is observed for magnetic-field strengths as large as 70 kG. This orbit probably results from magnetic breakdown across three different energy gaps. (Contractor's abstract)

470

Case Inst. of Tech. Dept. of Physics, Cleveland, Ohio.

MAGNETIC BREAKDOWN EFFECTS IN THE GALVANO-MAGNETIC PROPERTIES OF ZINC, by R. W. Stark. [1964] [16]p. incl. diagrs. (AFOSR-64-0185) (AF AFOSR-64-536) AD 611495   Unclassified

Also published in Phys. Rev., v. 135: A1698-A1713, Sept. 14, 1964.

The galvanomagnetic properties of several single-crystal specimens of high-purity zinc were investigated. The results of this investigation are presented and a Fermi-surface topology consistent with the data is discussed. Many of the detailed features of the galvanomagnetic properties are found to result from the effects of magnetic breakdown. The open orbit parallel to the hexagonal axis is modified but not eliminated by magnetic breakdown at fields of about 17.5 kG. A 'giant orbit' of the type previously observed in magnesium is found in zinc. This orbit results from magnetic breakdown across the energy gap near K which separates the second-band hole sheet from portions of the third band electron sheets. The transition region of the magnetic breakdown which gives rise to the giant orbit is investigated in detail, and the large quantum oscillations which have been previously observed in the transport properties of zinc are shown to be a transition-region phenomenon. The oscillations appear to result from an oscillatory breakdown probability which, in turn, arises from oscillations in the density of states associated with the Landau levels of the needle-shaped portion of the Fermi surface of zinc. An analysis of the detailed shape of the oscillations indicated that the Landau levels of the needle are split into discrete spin levels with a very large effective g factor.

471

Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

ON MOMENTS OF ORDER STATISTICS AND QUASI-RANGES FROM NORMAL POPULATIONS, by Z. Govindarajulu. [1963] 19p. (AFOSR-J1621) (AF AFOSR-62-72) AD 429252   Unclassified

Also published in Ann. Math. Stat., v. 34: 633-651, June 1963.

The lower bounds on the number of integrals to be evaluated is obtained in order to know the first, second and mixed (linear) moments of the normal order statistics (O. S.) in a sample of size N assuming that these moments are available for sample sizes less than N. Toward this, the recurrence relationships, identities, etc. among the moments of the normal order statistics, which have appeared in the literature have been collected with appropriate references. Also, these formulae are listed and stated in the most general form wherever possible. Simple and alternate proofs of some of these formulae are given. These results are also supplemented with new formulae or relationships. The lower moments of quasi-ranges in samples drawn from an arbitrary population symmetric about zero are expressed in terms of the moments of the corresponding O. S. Simple recurrence formulae among the expected values of quasi-ranges in samples drawn from an arbitrary continuous population are obtained. (Contractor's abstract)

472

Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

RELATIONS AMONG MOMENTS OF ORDER STATISTICS IN SAMPLES FROM TWO RELATED POPULATIONS, by Z. Govindarajulu. [1963] 5p. (AFOSR-64-0573) (AF AFOSR-62-72) AD 434303; AD 446893
                                        Unclassified

Also published in Technometrics, v. 5: 514-518, Nov. 4, 1963.

It is shown that the moments of order statistics in samples drawn from a population symmetric about zero can be expressed in terms of the moments of order statistics in samples drawn from the population obtained by folding the symmetric population at zero. Also, odd moments of the largest order statistic in samples of even sizes and even moments of the largest order statistic in samples of odd sizes drawn from the folded population can be expressed purely in terms of the moments of the order statistics in samples drawn from the symmetric population. The cumulative round off error involved in numerical evaluation of the moments of order statistics from the folded population, is not serious except for the mixed moments in which case a bound on the maximum error is available. An application is also considered. (Contractor's abstract)

473

Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

AN ELEMENTARY INFORMATION PROCESSOR FOR OBJECT RECOGNITION, by J. C. Pennypacker. May 1963, 105p. (Rept. no. SRC-30-I-63-1) (AFOSR-5112) (AF AFOSR-63-125) AD 413370; AD 901749   Unclassified

A Concept is defined to be a class of objects whose members can be distinguished by processing its properties. A Property is defined to mean a partition of the set of all objects into disjoint classes. The concept is described by a Conception, which is a list structure. The conception of a concept is built up from elementary conceptions by a recursive process and is an abbreviated form of the description list structure described by R. B. Banerji in an earlier paper. A Processor, which consists of a series of computer flow charts, is described. The processor is capable of forming conceptions of known and new concepts and is capable of processing information relevant to these concepts. In addition, the processor is capable of elementary learning. (Contractor's abstract)

474

Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

A HEURISTIC APPROACH TO SOLUTION OF CHECKER-BOARD PUZZLES, by G. J. Hansen. 1964, 94p. incl. diagrs. (Rept. no. SRC-49-A-64-16) (AFOSR-64-2406) (AF AFOSR-63-125) AD 609570   Unclassified

The problem of reconstructing a checkboard cut into a number of straight edge pieces was solved by a digital computer program employing a varity of heuristics. The major heuristics used were considerations of the symmetry of the pieces, correct color combinations, optimal selection of the place on the board to fit the next piece, the optimal piece to select at each stage in fitting the puzzle together, pairing of the pieces, and selecting the first piece to be used in starting the puzzle. These heuristics were applied in order to simulate as closely as possible the way in which a human being would proceed in obtaining a solution. It was possible to minimize the number of tries necessary to obtain a solution, thus making the solution time reasonable. Two 8 x 8 checkerboard puzzles were tried. The first consisted of 12 pieces and was solved in 8 min. The second had 13 pieces and took 1 hr and 25 min. The recursive program was written in IPL-V and run on the Univac 1107 computer. (Contractor's abstract)

475

Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

A THEORY OF SIMPLE CONCEPTS WITH APPLICATIONS, by T. G. Windeknecht. 1964, 122p. incl. refs. (Rept. no. SRC-53-A-64-19) (AFOSR-64-2407) (AF AFOSR-63-125) AD 609421 Unclassified

A theoretical study leading toward the solution of a class of inventory problems by digital computation is reported. Using a formal model of concepts in the activity of object recognition due to Banerji, a theory of simple concepts is constructed. The algebraic structure of the class of simple concepts is developed. A relationship between the formal notions of relevance and simplicity on the set of concepts is proved. The simple concepts are shown to be precisely that class that can be learned by a certain focusing strategy. Consideration of the characteristics of the set of simple concepts leads to a new technique for concept description, which is presented as a formalism. Progress on a concept learning machine based upon the proposed formalism for concept description is discussed. The machine will have a formidable capacity for self-organization, and appears to be applicable for solution of some of the inventory problems discussed. (Contractor's abstract)

476

Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

THE CONCEPT OF FINITE REPRESENTABILITY, by E. B. Altman. 1964, 155p. incl. diagrs. tables, refs. (Rept. no. SRC-56-A-64-20) (AFOSR-64-2408) (AF AFOSR-63-125) AD 609420 Unclassified

A subclass of the context-free grammars is developed which is based solely upon the structural properties of the grammars. This subclass is utilized in the development of a partial hierarchy of the entire class of context-free grammars. In turn this hierarchy makes possible the extension of certain information theory measures beyond the classical finite state limitations. Various restriction upon the method of generating sentences are introduced and the consequences of these restrictions are studied, in a general way, using mainly the introduced notion of production indexing sets. (Contractor's abstract)

477

Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

ADAPTIVE PATTERN RECOGNITION USING NON-LINEAR ELEMENTS, by A. N. Mucciardi. Oct. 1964, 131p. incl. diagrs. tables, refs. (Rept. no. SRC-65-A-64-22) (AFOSR-65-1701) (AF AFOSR-65-751) AD 623215 Unclassified

A pattern recognition device which computes a weighted sum of all products of its binary input variables is investigated. It is proven that this device can uniquely synthesize any real function of its inputs. The size of this device becomes prohibitive as the number of inputs increases and the concept of an incomplete device is introduced and discussed. A convergence proof of an adaptive training procedure for real outputs, based on the equivalence between this device and a multi-threshold linear device in a larger input space, is presented. A set of orthogonal property detectors is defined and shown to be numerically equal to the number of binary inputs. A computer simulation of a 64-input incomplete device shows that its generalizing abilities are more fully utilized with the aid of specific property detectors. A self-organizing technique consisting of periodically discarding low-weighted terms and replacing them with randomly chosen terms is discussed. Experiments conducted using this technique demonstrate that the learning and generalizing performances of the incomplete device are greatly improved if the device is free to change its structure according to a heuristic policy. (Contractor's abstract)

478

Catholic U. of America. [Dept. of Aeronautical Engineering] Washington, D. C.

RESEARCH ON FLOW SEPARATION IN WESTERN EUROPE, by P. K. Chang. July 1963, 28p. (AFOSR-4854) (AF AFOSR-62-80) AD 419245 Unclassified

The major scientific countries—France, Germany, and especially England—are well aware of the importance of the problems of flow separation and have engaged extensively in research. However, except for the Institut fur Schiffbau der Universitat, Hamburg, and in limited scope at Skipmodelltanken, Trondheim, Norway, it is felt that no special research on this subject has been carried on. Hence, most of the work listed herein was done at the aerodynamic institutes. The main emphasis in this research is placed on the fields of (1) Flow Separation on Swept Wings, (2) Base Flow, (3) Interaction between Shock Wave and Boundary Layer, and (4) Generalized Concept of Flow Separation. (Contractor's abstract)

479

Catholic U. of America. [Dept. of Chemistry]
Washington, D. C.

THE ELECTROCHEMICAL PROPERTIES OF METAL-
HYDROGEN ALLOYS, by G. W. Castellan. Final rept.
Jan. 4, 1963, 10p. (AFOSR-4561) (AF 49(638)475)
AD 609399   Unclassified

An investigation was made to examine the rate of trans-
mission of hydrogen through metals, both exothermic
and endothermic hydrogen occluders, and from this
examination to elucidate the mechanism of the process.
In the case of palladium it is shown that, on an anodically
activated surface in aqueous solution, the transmission
is almost exclusively controlled by the diffusion through
the bulk metal. However, the jump of a hydrogen atom
from the metal surface to the interior of the metal is
the next slowest step in the process. Using another
method work was done with alloys of palladium and
silver, 20% and 30% silver by weight. The results ob-
tained with these alloys does not appear to agree with
the observations of other investigators and this work
will have to be extended and rechecked.

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Catholic U. of America. Dept. of Chemistry,
Washington, D. C.

THE TRANSMISSION OF ELECTROLYTICALLY
DEPOSITED HYDROGEN THROUGH A PALLADIUM
MEMBRANE ELECTRODE. I. THE RATE EQUATIONS,
by G. W. Castellan. [1964] 4p. incl. tables, refs.
(AFOSR-65-0232) (AF 49(638)475) AD 611461
                                             Unclassified

Also published in Jour. Electrochem. Soc., v. 111:
1273-1276, Nov. 1964.

A sequence of elementary steps is postulated to de-
scribe the transport of hydrogen through a palladium
membrane electrode. The amount of hydrogen trans-
mitted per square centimeter of the membrane is de-
scribed by a current density, $-j$, while the rate of
deposition of hydrogen per square centimeter is de-
scribed by a polarization current density, $-i$. It is
shown in general, without reference to the particular
mechanism, that j is a linear function of i at low values
of i, and that the derivative, $(di/dj)_{i=0}$, is a linear
function of the membrane thickness L, provided only
that Fick's law in simple form holds; the slope of the
plot of $(di/dj)_{i=0}$ vs L is independent of conditions on
the exit side of the membrane. It is also shown in
general that if conditions are the same on both sides
of the membrane at equilibrium no more than one-half
of the hydrogen deposited can be transmitted. The
postulated mechanism predicts that the rate of trans-
mission should reach a limiting value, $-j_m$, at high
values of $-i$. For thin membranes, $1/(-j_m)$ should
be a linear function of L. The slope of $1/(-j_m)$ vs L
depends on the diffusion coefficient of hydrogen atoms
in palladium and is independent of the rates of the sur-
face reactions, although in some instances it depends

on θ_0, the equilibrium coverage of the surface by
hydrogen atoms.

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Catholic U. of America. Dept. of Chemistry,
Washington, D. C.

THE TRANSMISSION OF ELECTROLYTICALLY
DEPOSITED HYDROGEN THROUGH A PALLADIUM
MEMBRANE ELECTRODE. II. EXPERIMENTAL.
OXIDIZING AGENTS AND HYDROGEN GAS ON THE
EXIT SIDE, by R. A. LaPietra and G. W. Castellan.
[1964] [4]p. incl. diagrs. table. (AFOSR-65-0233)
(AF 49(638)475) AD 611346   Unclassified

Presented at meeting of the Electrochem. Soc., Los
Angeles, Calif., May 6-10, 1962.

Also published in Jour. Electrochem. Soc., v. 111:
1276-1279, Nov. 1964.

Hydrogen is deposited electrolytically on one side, the
entrance side, of a palladium membrane at a rate $-i$
(amp/cm^2). The amount of hydrogen transmitted is
measured by noting the change in normality of a solution
of a strong oxidizing agent, e. g., Ce^{++} of $S_2O_8^=$, on
the other side, the exit side, and in other experiments
by measuring the hydrogen evolved on the exit side
volumetrically. The results with hydrogen on the exit
side are apparently capable of description by the equa-
tions developed in Part I of this series, but the value of
the diffusion coefficient obtained is lower than Barrer's
value at 25°C by a factor of two to three. Possible
reasons for this discrepancy are discussed briefly.

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Catholic U. of America. Dept. of Chemistry,
Washington, D. C.

THE TRANSMISSION OF ELECTROLYTICALLY
DEPOSITED HYDROGEN THROUGH A PALLADIUM
MEMBRANE ELECTRODE. III. PRESSURE AND
TEMPERATURE DEPENDENCE, by P. L. Damour and
G. W. Castellan. [1964] 4p. incl. illus. diagrs. tables.
(AFOSR-65-0234) (AF 49(638)475) AD 611460
                                             Unclassified

Also published in Jour. Electrochem. Soc., v. 111:
1280-1283, Nov. 1964.

An investigation of the pressure and temperature de-
pendence of the maximum rate of transmission of hydro-
gen through palladium is described. The pressure de-
pendence in the range from 0.329 to 1 atm indicates that
the penetration-exit reaction, $H_{(ads)} = H$ (bulk), is the
slowest surface reaction, but is nonetheless very fast
having an exchange current density of about 0.8 amp/
cm^2 at 1 atm pressure. From the temperature depend-
ence it is found that at temperatures slightly below room
temperature the diffusion coefficient can be represented
by $D = 0.0260 \exp(-6800/RT) cm^2/sec$. (Contractor's
abstract)

483

Catholic U. of America. [Dept. of Mathematics]
Washington, D. C.

A LINEAR MAPPING OF THE SPACE OF DISTRIBU-
TION FUNCTIONS ONTO A SET OF BOUNDED CON-
TINUOUS FUNCTIONS, by E. Lukacs. Feb. 1, 1963,
6p. (AFOSR-64-1606) (AF AFOSR-61-32) AD 446897
Unclassified

In this paper, a characterization is given of the trans-
forms of distribution functions which utilize also the
continuity property. This assumption permits a more
general approach by considering instead of an integral
transform of distribution functions a linear mapping of
the space of distribution functions. (Contractor's
abstract)

484

Catholic U. of America. [Dept. of Mathematics]
Washington, D. C.

APPLICATIONS OF CHARACTERISTIC FUNCTIONS,
by E. Lukacs and R. G. Laha. London, Charles
Griffin and Co. Ltd., 1964, 202p. incl. refs.
(Griffin's Statistical Monographs & Courses no. 14)
(AFOSR-65-1591) (AF AFOSR-61-32) AD 620239
Unclassified

Applications of characteristic functions to problems of
theoretical statistics are considered. Some multivari-
ate distributions which occur in statistical problems
are studied, and the distribution problem of statistics
is solved in those cases where the integrals of the dis-
tribution function can be evaluated. Independent sta-
tistics are discussed and situations in which they de-
termine the distribution functions of random variables,
considered. Some regression problems, problems in
the theory of stochastic processes, stability theorems,
and identically distributed statistics are studied. Most
theorems presented are given with detailed proofs.
(Contractor's abstract)

485

Catholic U. of America. [Dept. of Mathematics]
Washington, D. C.

CHARACTERIZATION PROBLEMS FOR DISCRETE
DISTRIBUTIONS, by E. Lukacs. [1963] 10p. (AFOSR-
66-1677) (AF AFOSR-63-437) AD 641690
Unclassified

Also published in Proc. Internat'l. Symposium on
Classical and Contagious Discrete Distributions,
Montreal (Canada), 1963, p. 65-74.

Assumptions concerning the properties of the distribu-
tions of certain statistics, based on a sample from a
population, will in general impose restrictions on the
population distribution function. Characterization prob-
lems deal with the question of finding assumptions which
determine the population distribution function at least
to the extent that it belongs to a certain family of dis-

tribution functions. A great variety of assumptions is
studied in connection with characterization problems:
these problems were surveyed in papers presented at
the third and fourth Berkeley symposiums. In this
paper only a regression property of certain statistics
is considered.

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Catholic U. of America. [Dept. of Physics]
Washington, D. C.

ALPHA-PARTICLE RESONANCE, by C. Werntz.
[1964] 6p. (AFOSR-64-0636) (AF AFOSR-62-56)
AD 435946 Unclassified

Also published in Phys. Rev., v. 133: B19-B24,
Jan. 13, 1964.

A phase-shift analysis of the elastic P-T cross section
in the energy range 0.1 to 0.76 mev has been made. It
is shown that the low peak observed at 0.3 mev is con-
sistent with a 0(+) resonance at 0.5 = 0.1 mev. The
shape of the observed cusp in the P-T elastic cross
section at the threshold energy of the N-He$_3$ channel is
used to demonstrate that the energy behavior of the
singlet and triplet s-wave phase obtained must be
qualitatively unique. A direct comparison is made of
the Breit-Wigner single-level approximation and the
alternative two-channel scattering length description
of the state. (Contractor's abstract)

487

Catholic U. of America. Dept. of Physics,
Washington, D. C.

STATISTICAL MECHANICS OF QUENCHED SOLID
SOLUTIONS WITH APPLICATION TO MAGNETICALLY
DILUTE ALLOYS, by T. Morita. [1964] 5p. (AFOSR-
65-1117) (AF AFOSR-63-445) AD 620534
Unclassified

Also published in Jour. Math. Phys., v. 5: 1401-
1405, Oct. 1964.

For the motion of atoms in solid solutions or alloys
prepared at high temperatures and cooled nonadiabati-
cally, theories of phenomena related to internal de-
grees of freedom must account for the nonequilibrium
distribution of atoms. However, such a system can be
treated with the aid of a fictitious equilibrium system.
The system is constructed such that its thermal equi-
librium properties are the same as the properties of
the non-thermal-equilibrium system. Thus one can
treat nonequilibrium systems by applying well known
thermal equilibrium techniques to the fictitious system.
The method is illustrated via the example of a mag-
netically dilute alloy. Brout's result for a very dilute
Ising system is obtained with the aid of the theory of
classical fluids, without collecting diagrams. A method
for applying the higher approximations developed for
classical fluids to the present problem is suggested.

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Catholtc U. of Chile. [Lab. of Neurophysiology] Santiago.

ROLE OF Th 2 CEREBRAL CORTEX IN CLASSICAL AND INSTRUMENTAL CONDITIONED REFLEXES, by S. Middleton. Final technical rept. May 1, 1963- Apr. 30, 1964. Aug. 1964, 6p. (AFOSR-64-1441) (AF AFOSR-62-387) AD 604477   Unclassified

Summaries of psychophysiological reports are presented concernlng the role of the cerebral cortex in conditioned reflexes.

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Catholic U. of Chile. [Lab. of Neurophysiology] Santiago.

AN ELECTRICAL CORRELATE TO THE PROCESS OF LEARNING. EXPERIMENTS IN BLATTA ORIENTALIS, by J. V. Luco and L. C. Aranda. [1964] 3p. incl. diagr. table. (AFOSR-65-0298) (AF AFOSR-62-387) AD 612221   Unclassified

Also published tn Nature, v. 20: 1330-1331, Mar. 28, 1964.

The report deals with the question of differences between the electrical reaction of the nervous system of normal cockroaches compared with cockroaches forced to learn a new motor performance.

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Catholic U. of Chtle. Lab. of Neurophysiology, Santiago.

PLASTICITY OF NEURAL FUNCTION IN LEARNING AND RETENTION, by J. V. Luco. [1964] 25p. incl. illus. diagrs. table, refs. (AFOSR-65-1501) (AF AFOSR-62-387) AD 623062   Unclassified

Also publtshed in Bratn Function: RNA and Brain Function; Memory and Learning; Proc. Second Conf., Los Angeles, Calif., 1962, Los Angeles, California U. Press, v. 2: 135-159, 1964. (AFOSR-65-1499)

An electrophysical approach to the neural basis of plasticity, deftned broadly by the author as the central nervous system's quality of being versatile is discussed. The in vitro experiment was performed on the sixth abdominal and the metathoractc ganglion of Blatta orientalis. Stimulation of the nerve tracts which connect the ganglion with others eltcits several different types of responses, all recorded from the motor fibers and quite frequently from a single untt. The servile response ts charactorized by faiigue properties, the labile response by its variable response to different frequency sti muli, and the intratetanic by the responses elictted after tetantc conditions are introduced. After-discharge, delayed, and natural responses are also described. Analysis of the six responses in ierms of their plasttctty or tendency toward modification by past expertence, indicated that the labile response reaction and the tntratetantc response are definitely piastic.

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[Catholic U. of Chile. Lab. of Physiology, Santiago]

[PEPTIDE NEUROHUMORS IN THE BRAIN] Final rept. Dec. 1963, 1v. (AFOSR-64-0015) (AF AFOSR-62-424) AD 429272   Unclassifted

The experiments described deal with the effects of ptneal and habenular extracts on renal excretion of Na, K, and water. These experiments were carrted out on the assumption that the pineal gland would contain some of the substances active on hydro-mineral metabolism described in literature, such as adrenoglomerulotrophtn. The total extracts of the cerebral cortex, pineal, and epithalamus reduce the ovarian ascorbic actd when assayed in Parlow's test. Serotonin in doses of 25μ g has a depleting action on the ovarian ascorbtc acid; melatontn does not. The extracts, 15 min after intravenous injection, increase the LH-ltke activity of the plasma in castrated rats treated with Estradiol and Progesterona. Serotonin in dcses of 50μ g did not produce this effect. The behavior of the extracts is that of a LH-releasing factor. (Contractor's abstract)

492

Centre National de la Recherche Scientifique, Paris (France).

LIGHT ENERGY CONVERSION IN NEURONAL MEMBRANES, by N. Chalazonitis. [1964] [31]p. incl. illus. diagrs. table, refs. (AFOSR-65-1293) (AF EOAR-63-114) AD 621413   Unclassified

Presenied at Symposium on Molecular Mechantsms in Photobiology, Wakulla Springs, Fla., Feb. 16-21, 1964.

Also published in Photochem. and Photobiol., v. 3: 539-559, 1964.

Photocurrents and decrease in membrane reststance have been shown by illuminating pigmented nei ve cells, and vitally stained nerve fibers. Any photocurrent, of threshold value, can elicit repetitive electrical activity as an extrinsic outward current dose. In pigmented nerve cells, photocurrents are additive to pre-existing dark currents, thus modifying the frequency of the spontaneous activity. Light effects on electrogenic membrane were compared to those of IR. Both radiations decrease, with different yields, the membrane resistance. However, the initiated membrane currents are generally of opposite directions. Similarly, oppostte direction photocurrents are elicited by specific illuminations of 2 intracellular pigments, haemoprotein or carotenoid, in some nerve cells. (Contractor's abstract)

493

Centre National de la Recherche Scientifique, Paris (France).

[PRESSURE CHAMBER FOR MICROELECTRO-PHYSIOLOGICAL TECHNIQUES] Caisson de

compression pour techniques mtcroelectrophysio-
logiques, by R. Chagneux. [1964] [7]p. incl. illus.
diagr. (AFOSR-65-1294) (AF EOAR-63-114)
AD 621281   Unclassified

Also published in Bull. Inst. Oceanog., v. 61: 2-8,
1964.

Thts research program on the effect of hyperbar gases
on isolated nerve cells of Aplysia has involved the study
and construction of a pressure chamber. The chamber
is mainly composed of a cylindrical tube, with 2 glass
port-holes allowing the illumination and observation of
the biological preparations, and 2 moveable doors with
a quick-closing system which permtt mtcromanipula-
tion. Electrical connections assure all the various
remote controls. Two taps, purge and stop, a manome-
ter and a safety valve complete the equtpment of the
chamber. The equipmeni meets the requirements of
microelectrophysiological techniques and can submit
the preparations to constant pressures of as much as
6 bars. (Contractor's abstract)

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Chicago U., Ill.

NATIONAL INTEGRATION AND POLITICAL DEVELOP-
MENT, by L. Binder. [1964] [10]p. incl. refs.
(AFOSR-65-1162) (AF AFOSR-64-582) AD 621464
                                    Unclassified

Also published in Amer. Political Sci. Rev., v. 58:
622-631, Sept. 1964.

The relationship between national integration and
political development is explored. The two conceps
are held io be situationally bound phenomena, and
understanding is sought by exploring their different
aspects io form a model rather than by searching for
concrete definitions of the two. National integration
and an effective bureaucracy are considered to be
strongly interdependent. The political relationship
between the modernizing elite and the traditional mass
ts thought to be the key issue in national iniegration.
Given special atiention are Mosca's ideas of social type
and political formula. In the model constructed, stable
political forms will be shaped by the integrative process,
if ai all. (Contractor's abstract)

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Chicago U. [Commitiee on Mathematical Biology] Ill.

ON THE REVERSIBILITY OF ENVIRONMENTALLY
INDUCED ALTERATIONS IN ABSTRACT BIOLOGICAL
SYSTEMS, by R. Rosen. [1963] 10p. (AFOSR-3204)
(AF 49(638)917) AD 413635   Unclassified

Also publtshed in Bull. Math. Biophys., v. 25: 41-50,
1963.

The environmentally induced alterations tn structure
of biological sysiems which were described previously
are examined from the str.ndpoint of determtning under
whai circumstances they can be reversed by further

environmental tnteractions. For simplicity, consider
only the case of biological systems possessing one
metabolic and one genetic component. In the case of
environmentally induced alteration of the metabolic
component alone, a necessary and sufficient condition
is given for the reversibility of the alteration. In the
case of alteration of the genetic component, the situation
becomes more complex; several partial results are
given, but a full analysis is noi available at thts time.
Some possible biological implications of this analysts
are discussed. (Contractor's abstract)

496

Chicago U. [Committee on Mathematical Biology] Ill.

AN AVOIDANCE LEARNING SITUATION. A NEURAL
NET MODEL, by H. D. Landahl. [1964] 7p. (AFOSR-
64-0959) (AF AFOSR-63-370) AD 439983; AD 436112
                                    Unclassified

Also published in Bull. Math. Biophys., v. 26: 83-89,
1964.

A simple avoidance situation is constdered in terms of
a neural net learning model. Data for the control
situation can be represented by an expression having
three parameters which determine the initial and the
steady state activities together with transient aspects.
The introduction of a learning parameter then allows
one to calculate satisfactorily the results obtained in
the experimental situation in which shock is applied.
(Contractor's abstract)

497

Chicago U. [Committee on Mathematical Biology] Ill.

AN ANALOG COMPUTER MECHANIZATION OF THE
HODGKIN-HUXLEY EQUATIONS, by H. M. Martinez
and H. D. Landahl. Oct. 1, 1964, 25p. (AF AFOSR-
63-370) AD 608156   Unclassified

The Hodgkin-Huxley equations describing the action
potentials for giant squid axons have been mechanized
on the University of Chicago analog computer (Beekman
EASE 2132) for the purpose of simulating a variety of
experimental situations. The mechanizattor. is descrtbed
together wtth the fcllowtng results: (1) response to
constant currents ranging from threshold to saturatior,
(2) response to 100 cps stnusoidal current at 2 amplitudes
and 2 phases, and (3) the effeci of removtng the potas-
sium current term. (Contractor's abstract)

498

Chicago U. [Committee on Mathematical Biology] Ill.

ABSTRACT BIOLOGICAL SYSTEMS AS SEQUENTIAL
MACHINES, by R. Rosen. [1964] 9p. (AFOSR-64-
1851) (AF AFOSR-64-9) AD 453598; AD 444059
                                    Unclassified

Also publtshed in Bull. Math. Btophys., v. 26: 103-111,
1964.

It is shown that a rather close relationship exists between the (M, R)-system, defined previously as prototypes of abstract biological systems, and the sequential machines which have been studied by various authors. The theory of sequential machines is reformulated in a way suitable for its application to the study of the intertransformability of (M, R)-systems as a result of environmental alteration. The important concept of strong connectedness is most useful in this direction, and is used to derive a number of results on intertransformability. Some suggestions are made for further studies along these lines. (Contractor's abstract)

499

Chicago U. Committee on Mathematical Biology, Ill.

ABSTRACT BIOLOGICAL SYSTEMS AS SEQUENTIAL MACHINES. II: STRONG CONNECTEDNESS AND REVERSIBILITY, by R. Rosen. [1964] [8]p. (AFOSR-65-0967) (AF AFOSR-64-9) AD 614871
Unclassified

Also published in Bull. Math. Biophys., v. 26: 239-246, 1964.

It was previously shown that the abstract biological systems called (M, R)-systems could be regarded formally as sequential machines, and that when this was done, the reversibility of environmentally induced structural changes in these systems was closely related to the strong connectedness of the corresponding machines. In the present work it is shown that the sequential machines arising in this way are characterized by the property that the size of the input alphabet is very small compared with the size of the set of states of the machine. It is further shown that machines with this property almost always fail to be strongly connected. Therefore, it follows that one of the following alternatives holds: either most environmentally induced structural alterations are not environmentally reversible, or else many mappings in the category from which the (M, R)-systems are formed must not be physically realizable.

500

Chicago U. Committee on Mathematical Biology, Ill.

TOWARD AN OPTIMAL DESIGN PRINCIPLE IN RELATIONAL BIOLOGY, by H. M. Martinez. [1964] [15]p. incl. diagr. (AFOSR-65-0968) (AF AFOSR-64-9) AD 614872
Unclassified

Also published in Bull. Math. Biophys., v. 26: 351-365, 1964.

A vulnerability criterion is posed for a biological system within the context of representing the system as a relational set, i.e., a collection of components whose interdependency is described by means of a set of binary relations. The criterion provides a numerical value for each representation and therefore a means for comparing one representation against another. Choice of the criterion is such that the larger a numeri-

cal value a representation has then the less vulnerable to destruction is the system represented. Other things beng equal, it is argued that the representation which endows the system with the least vulnerability is more likely to be a valid representation. A selection criterion is thereby acheived for narrowing down the choice of a priori representations. (Contractor's abstract)

501

Chicago U. [Dept. of Chemistry] Ill.

REACTIVE INTERMEDIATES IN CYCLOPROPANE CHEMISTRY, by W. G. Brown. Final rept. 1964, 7p. (AFOSR-64-1419) (AF AFOSR-63-80) AD 444507
Unclassified

Part I of this report summarizes the results of studies on the photolysis products of phenyl cycloalkyl ketones and presents some conclusions with regard to geometrical factors in Type II photolysis reactions. Part II deals with an expression of cyclopropyl hydrogen lability with allylic activation as measured by the base-catalyzed interconversion of cis- and trans-2,3- dimethyl-1-methylenecyclopropane. (Contractor's abstract)

502

Chicago U. [Dept. of Mathematics] Ill.

ON THE PRINCIPLE OF THE EXCHANGE OF STABILITIES. I. THE ROCHE ELLIPSOIDS, by N. R. Lebovitz. [1963] [4]p. (AFOSR-65-1003) (AF AFOSR-62-136) AD 619113
Unclassified

Also published in Astrophys. Jour., v. 128: 1214-1217, Nov. 15, 1963.

The principle of the exchange of stabilities is discussed in the context of the Roche ellipsoids. The stability equations for the Roche ellipsoids are given, and it is shown that the vanishing of a characteristic frequency does not imply that the corresponding normal mode is stationary; nor does a stationary normal mode necessarily imply the occurrence of a point of bifurcation. It is concluded that despite the vanishing of a characteristic frequency at the onset of instability, there is no exchange of stabilities. (Contractor's abstract)

503

Chicago U. [Dept. of Mathematics] Ill.

AN ELEMENTARY THEORY OF THE CATEGORY OF SETS, by F. W. Lawvere. [1964] 6p. (AFOSR-66-0033) (AF AFOSR-64-520) AD 641629 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 52: 1506-1511, Dec. 1964.

The author adjoins eight-first-order axioms to the usual first-order theory of an abstract Eilenberg-Mac Lane category to obtain an elementary theory with the following properties. (a) There is essentially only one category which satisfies these eight axioms together with the

additional (nonelementary) axiom of completeness, namely, the category $\mathcal{S}$ of sets and mappings. This theory distinguishes $\mathcal{S}$ structurally from other complete categories, such as those of topological spaces, groups, rings, partially ordered sets, etc. (b) The theory provides a foundation for number theory, analysis, and much of algebra and topology even though no relation ϵ with the traditional properties can be defined. The authors seems to have partially demonstrated that even in foundation, not substance but invariant form is the carrier of the relevant mathematical information.

504

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

ABSORPTION OF Σ^- HYPERONS IN PHOTOGRAPHIC EMULSION NUCLEI, by B. Anderson, O. Skjeggestad, and D. H. Davis. [1963] [4]p. incl. diagrs. refs.
(AFOSR-65-0463) (AF 49(638)209) AD 614213
Unclassified

Also published in Phys. Rev., v. 132: 2281-2284, Dec. 1, 1963.

396 Σ^- capture stars in nuclear emulsion have been analyzed. The new data have been combined with 231 similar events previously reported. The rate of hyperfragment emission from Σ^- stars is $(2.7 ^{+0.5}_{-0.4})\%$. Both this rate and an estimate of the frequency of cryptofragment formation are compared with the analogous quantities pertinent to K^- absorptions at rest. Evidence is presented that hyperfragments predominantly originate from Σ^- absorptions in the light elements of the emulsion, while cryptofragments are formed following Σ^- absorption in heavy nuclei.

505

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

A DETERMINATION OF THE SPIN OF $_\Lambda \text{Li}^8$, by D. H. Davis, R. Levi Setti, and M. Raymund. [1963] [5]p. incl. diagrs. table, refs. (AFOSR-65-0464) (AF 49(638)209) AD 614187 Unclassified

Also published in Nuclear Phys., v. 41: 73-77, 1963.

Forty-three events representing the decay $_\Lambda \text{Li}^8 \to \pi^-$ $\text{He}^4 \text{He}^4$ have been collected. Evidence is presented which shows that this decay proceeds almost exclusively through states of Be^8. The predominance of the 2.9 mev 2 Be^8 level together with the angular distribution of the decay products for events involving this level suggest that the spin of $_\Lambda \text{Li}^8$ is 1. (Contractor's abstract)

506

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

HYPERFRAGMENT PRODUCTION BY 4.5 GEV/c

π- MESON INTERACTIONS IN EMULSION NUCLEI. A REAPPRAISAL, by J. Zakrzewski, D. H. Davis, and O. Skjeggestad. [1963] [8]p. incl. diagrs. refs. (AFOSR-65-0836) (AF 49(638)209) AD 617872
Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 652-659, Feb. 1, 1963.

The hyperfragment production by fast π-meson interactions is shown to be well explained by the model of Jones et al (Phys. Rev., v. 127: 236, 1962). The short range hyperfragments are shown to be predominantly very heavy and not light as had been supposed. The conclusions of other investigators are examined with recourse to this fact. (Contractor's abstract)

507

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

BINDING ENERGY OF Λ^0 HYPERONS IN HEAVY HYPERNUCLEI ($60 < A < 100$), by D. H. Davis, R. Levi-Setti and others. [1962] [3]p. incl. diagrs. table. (AFOSR-65-0837) (AF 49(638)209) AD 617044
Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 464-466, Dec. 1, 1962.

In this note the binding energy of Λ^0 hyperons in heavy hypernuclei is studied. Measurements were made of 470 nonmesonic disintegrations of spallation fragments resulting from 2 Ilford K5 emulsion stacks exposed to a 800- mev/cK^--meson beam. The total visible energy histogram is given, and the upper limit of B_Λ is calculated as 35 mev. The details of five π-mesonic decays of similar hypernuclei are given, and it is noticed that the total visible energy release is much smaller than that usually associated with the mesonic decays of light hyperfragments. Results indicate that the upper limit of B_Λ may be set at 25 mev. A B_Λ vs $A_{core}^{-2/3}$ plot is given, and it is seen that the value for the Λ-nucleus potential well depth cannot much exceed 30 mev.

508

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

RECENT INVESTIGATIONS OF THE LOW ENERGY COSMIC AND SOLAR PARTICLE RADIATIONS, by J. A. Simpson. 1963, 30p. (AF 49(638)1008) AD 434654 Unclassified

Also published in Pontificiae Acad. Scientiarum Scripta Varia, v. 25: 323-352, 1963.

The first part of this paper is a preliminary study of changes in intensity and spectrum of the solar modulated cosmic radiation over a solar activity cycle. Neutron intensity monitors responsive to changes in primary particle magnetic rigidity as low as approximately GV have been analyzed for the period 1952-1962. It appears that the experimental results are to be explained by the growth and decay of a modulation electrodynamical region bounding a large volume of interplanetary

space. The nonlinear growth and decay are functions of both solar activity and particle magnetic rigidity. The second part is a report on recent experiments to study the origin of 8°-35° mev primary protons shown to be continuously present during years near maximum solar activity. (Contractor's abstract)

509

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

MAGNETOSPHERIC CUTOFF FOR 1.5-MEV EXTRA-TERRESTRIAL PROTONS, by C. Y. Fan, J. A. Simpson, and E. C. Stone. [1964] 3p. (AFOSR-64-1148) (AF AFOSR-62-23) AD 442831 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 269-271, Mar. 16, 1964.

A study over the geomagnetic polar regions of the arrival of extraterrestrial low-energy protons during a period of low geomagnetic activity is important both for a physical description of the distant magnetosphere and for understanding the ionization of the upper atmosphere over the polar regions by solar flare protons. Investigations below about 20 mev have been possible only recently with detectors on polar orbiting satellites. Results are reported from an oriented satellite whose orbit passed over the geomagnetic pole carrying detectors sensitive to 1.5-mev protons from both the vertical and horizontal directions and insensitive to electrons. (Contractor's abstract)

510

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

SOLAR FLARE HIGH ENERGY ALPHA PARTICLES AND THEIR STORAGE IN INTERPLANETARY SPACE, by G. K. Yates. [1964] [19]p. incl. diagrs. tables, refs. (AFOSR-65-0468) (AF AFOSR-62-23) AD 614217 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3077-3095, Aug. 1, 1964.

The present paper reports the results of measurements of the relativistic α particles by a scintillation counter telescope and a Cerenkov counter flown by high altitude balloon late during the solar flare event of Nov. 12, 1960. It showed that the sun does produce relativistic α particles. These high energy results, when compared with the fluxes of 50 to 120 mev per nucleon α particles measured by others at the same time, show that the kinetic energy and magnetic rigidity spectrums of the solar α particles are in the form of power laws. Further, the time variations in the solar α-particle flux observed here suggest an interesting model for the propagation and storage of solar accelerated particles in this event. (Contractor's abstract)

511

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

LOCAL TIME DEPENDENCE OF NON-STÖRMER CUTOFF FOR 1.5-MEV PROTONS IN QUIET GEOMAGNETIC FIELD, by E. C. Stone. [1964] [6]p. incl. diagrs. table. (AFOSR-65-0469) (AF AFOSR-62-23) AD 613824 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3577-3582, Sept. 1, 1964

Two solid state detector telescopes, vertically and horizontally oriented, were launched into a polar orbit during a time of low geomagnetic activity. A small flux of 1.5-mev protons, interacting with the geomagnetic field as individual particles, was observed at all latitudes above a characteristic cutoff latitude. The observed vertical cutoff was 65° on the night side and 67° on the day side, as compared with a theoretical Störmer cutoff at 76°. The local time dependence was also apparent in the cutoff transition width characterized by the difference in the latitude at which the flux is first detectable and the latitude at which the maximum flux is first observed. On the night side, the transition width was about 1°, on the day side it was about 3° and variable. The horizontal cutoff latitudes were similar. Essentially identical results were obtained over north and south poles. These results are not adequately predicted by currently postulated cutoff theories and should be considered in the calculation of proton fluxes associated with polar-cap absorption. (Contractor's abstract)

512

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

A MEASUREMENT OF THE PRIMARY PROTON FLUX FROM 10 TO 130 MILLION ELECTRON VOLTS, by E. C. Stone. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0470) (AF AFOSR-62-23) AD 613825 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3939-3945, Oct. 1, 1964.

A counter telescope, composed of 9 AuSi solid-state detectors for measuring the energy loss and range of vertically incident particles, was carried into a polar orbit by an oriented satellite on Dec. 12, 1961. The choice of detectors and absorbers allowed separation of protons and α particles with energies between 10 and 250 mev/nucleon. Although the quantity of data was limited by the failure of the vehicle transmitter, both the observed 85- to 130-mev proton flux and the α-particle flux are consistent with other 1961 observations. In addition, a proton flux of ~ 1 m^{-2} sec^{-1} $ster^{-1}$ mev^{-1} was measured in the energy range 10-85 mev, indicating that the quiet time spectrum was much "flatter" than the E^{-2} spectrum that others have observed at higher energies.

513

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

SOME POSSIBILITIES FOR UNUSUAL LIGHT HYPER-NUCLEI, by R. H. Dalitz and R. Levi-Setti. [1963] [13]p. incl. refs. (AFOSR-65-0471) (AF AFOSR-62-358) AD 614539   Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 489-501, Oct. 16, 1963.

Some possibilities are considered concerning the stability, formation, and inentification of Λ-hypernuclei corresponding to core nuclei generally with $I \geq 3/2$ away from the stability valley. The identification of such hypernuclei may be rather informative concerning the existence and properties of such little-known nuclei. For neutron-rich species, e.g., $_\Lambda H^6$, $_\Lambda He^8$, the possible confusions of their major decay modes with and their separation from similar well-established modes of more abundant hypernuclei are discussed. The expectation that narrow resonance levels with lifetimes $\geq 10^{-21}$ s should exist for certain hypernuclear systems, e.g., the $P-_\Lambda He^4$ system is also mentioned briefly since the production and observation of such resonance states could be achieved with existing techniques. (Contractor's abstract)

514

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE BINDING ENERGY DIFFERENCE BETWEEN THE HYPERNUCLIDES $^4He_\Lambda$ AND $^4H_\Lambda$, by M. Raymund. [1964] [33]p. incl. diagrs. tables, refs. (AFOSR-65-0472) (AF AFOSR-62-358) AD 614740   Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 555-587, May 1964.

Experimental and theoretical studies indicate a departure from charge symmetry for the mirror hypernuclides $_\Lambda He^4$ and $_\Lambda He^4$ amounting to a few tenths of a mev in the binding energies. A nuclear emulsion experiment utilizing 45 newly measured π-mesic decays of $_\Lambda He^4$ and $_\Lambda H^4$ is reported to give $\Delta_\Lambda B = _\Lambda B(_\Lambda He^4) - _\Lambda B(_\Lambda H^4) = (0.55 \pm 0.26)$ mev. By adding events from the literature to this sample, a total of 214 π-mesic decays of these hypernuclides was obtained. This number proved sufficient to resolve the difficulties previously encountered in an experimental evaluation of $\Delta_\Lambda B$. Contamination by other hypernuclides, probably $_\Lambda He^5$ was eliminated from the $_\Lambda He^4$ sample by a strict recoil-range requirement $R_{rec} \geq 10\mu m$; on the other hand, no contaminants were found among the $_\Lambda H^4$ decays. The binding energy discrepancy between the πr and π pr decays of $_\Lambda H^4$ was found to be due to pion range measurement losses which are important mainly for the πr events $R_{\pi\sim}4$ cm. The final value of $\Delta_\Lambda B$ for the latter sample is 0.30 ± 0.14 mev. Because a negative term in the theoretical calculation of $\Delta_\Lambda B$ is expected from a Coulomb energy increase in the He^3 core of

$_\Lambda He^4$, this positive experimental result is a strong indication of charge-symmetry violation in the $_\Lambda N$ interaction compatible with estimates of the virtual electromagnetic effects in $\Lambda \to \Lambda + \tau^0$ suggested by theoretical workers. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

DISCUSSION OF PAPER BY E. J. STEGELMANN AND C. H. VON KENSCHITZKI, "ON THE INTERPRETATION OF THE SUDDEN COMMENCEMENT OF GEOMAGNETIC STORMS," by E. N. Parker and A. J. Dessler. [1964] [4]p. (AFOSR-65-0509) (AF AFOSR-64-521) AD 614168   Unclassified

Also published in Jour. Geophys. Research, v. 69: 3745-3748, Sept. 1, 1964.

Stegelmann and von Kenschitzki state that rays computed from Fermat's principle cannot be taken literally for waves with periods above about 1 sec, because the wavelengths for these waves are larger than the distance over which the propagation velocity changes appreciably in the region of maximum hydromagnetic velocity. On the basis of ray tracing, only a small region at the subsolar point contributes to the initial rise of the sudden commencement, owing to the enormous refraction that takes place as the ray approaches the hydromagnetic velocity maximum. It clearly contradicts the general principle that the pressure on the entire boundary contributes to the compression; nevertheless it is suggested that a consideration of propagation time of hydromagnetic disturbances can lead to an understanding of phenomena like delay times and earlier arrival of sudden commencements at medium and high latitudes, and even a rough understanding of rise times. Parker and Dessler support this theory and conclude that the major part of the rise time of the sudden commencement at any point on the surface of the earth can be estimated from the hydromagnetic propagation times. But ray tracing breaks down, and more powerful methods must be employed to advance beyond the present state of approximate estimates.

516

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

PRODUCTION OF HYPERFRAGMENTS BY THE INTERACTIONS OF 1.5 GEV/c K⁻ MESONS IN LITHIUM-LOADED EMULSIONS, by M. J. Beniston, R. Levi-Setti and others. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0510) (AF AFOSR-64-556) AD 613883   Unclassified

Also published in Phys. Rev., v. 134: B641-B648, May 11, 1964.

Hyperfragment production by some 31,000 interactions of 1.5 gev/c K⁻ mesons in Li-loaded K5 nuclear emulsions has been studied and compared with data from 0.8-gev/c and existing data from 1.5-gev/c K⁻ interactions in normal emulsions. The study of the prong number distributions of the hyperfragment parent stars

provides a sensitive method for determining the production rates of hyperfragments by K^- interactions with light C, N and O and heavy Ag and Br emulsion nuclei; these production rates are found to be $0.66 \pm 0.11\%$ and $5.20 \pm 0.20\%$, respectively. An appreciable proportion of mesonic hyperfragments $Z < 6$ and Li fragments have very short ranges $R_{HF} \leq 10 \mu$; this fact indicates the possibility of contaminations of "light" hypernuclides among the assumed mesic spallation hyperfragments. The predominant part of the hyperfragment production stars which shows the emission of "short" prongs involves the disintegration of heavy nuclei, thus indicating that Coulomb-barrier criteria cannot be used in discriminating among light or heavy hyperfragment parent stars at high K^- momenta. No double hyperfragment was observed. One K^- interaction emitted 2 hyperfragments decaying nonmesically. The π^+ decay of a $_\Lambda He^4$ hyperfragment has been found. An estimate of the branching ratio R of the π^+ decay and π^- decay modes for the $_\Lambda He^4$ hypernucleus gives $R \leq 2.7 \pm 1.1\%$.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

POSSIBLE EXISTFNCE OF A p-He^3 RESONANCE WITH Q = 11 MEV PRODUCED IN $_\Lambda He^4$ DECAY, by M. J. Beniston, B. Krishnamurthy and others. [1964] 3p. incl. diagr. table, refs. (AFOSR-65-0827) (AF AFOSR 54-556) AD 629853   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 553-555, Nov. 2, 1964.

An effect in the π (= energy histogram from $_\Lambda He^4$ decays in nuclear emulsions has been observed, and is best interpreted as evidence for an excited state of Li^4 (10.62 ± 0.20) mev above decay to proton and He^3. The width observed is (0.23 ± 0.20) mev, which agrees with the pion energy resolution (about 0.40 mev) in nuclear emulsions only if the upper limit (0.43 mev) is taken. The narrow resonance width at this excitation energy could be understood in terms of an I = 2 state of Li^4 whose p-He^3 decay would be forbidden by isospin conservation. (Contractor's abstract)

518

Chicago U. [Inst. for the Study of Metals] Ill.

PROPERTIES OF SOLUTIONS OF METALS IN MOLTEN SALTS, by N. H. Nachtrieb. Final technical rept. Jan. 26, 1964, 42p. incl. illus. diagrs. tables, refs. (AFOSR-64-0295) (AF 49(638)1076) AD 434538   Unclassified

Research into the properties of molten salts followed five lines of investigation: (1) nuclear magnetic resonance, (2) electrical conductance, (3) surface tension, (4) magnetic susceptibility, and (5) absorption spectra. Progress in each is summarized. (Contractor's abstract)

519

Chicago U. Inst. for the Study of Metals, Ill.

PROBES FOR HIGH TEMPERATURE NUCLEAR MAGNETIC RESONANCE, by S. Hafner and N. H. Nachtrieb. [1964] 3p. (AFOSR-64-1549) (AF 49(638)1076) AD 446129   Unclassified

Also published in Rev. Scient. Instr., v. 35: 680-682, June 1964.

Two designs are described for single coil NMR probes and furnaces with the Varian wide line spectrometer (V-4210) to temperatures up to 1000°C. Their application to molten salt systems is outlined. (Contractor's abstract)

520

Chicago U. Inst. for the Study of Metals, Ill.

NUCLEAR MAGNETIC RESONANCE IN MOLTEN SALTS. I. CHEMICAL SHIFT OF CRYSTALLINE AND MOLTEN THALLIUM SALTS, by S. Hafner and N. H. Nachtrieb. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-1550) (AF 49(638)1076) AD 446111   Unclassified

Also published in Jour. Chem. Phys., v. 40: 2891-2898, May 15, 1964.

Relatively large chemical shifts in the resonance frequency of the thallium nucleus are observed in both the crystalline and molten states of different thallium salts. Relative to $TlNO_3$, which appears to be the most ionic of all thallium salts studied, the Tl^{205} resonance frequency at fixed field increases in the order: $NO_3^- < Cl^- < Br^- < I^-$. The results are interpreted in terms of a second-order paramagnetic contribution to the field at the Tl nucleus arising from an admixture of its excited states with the ground state, and the chemical shift is approximately proportional to the square of the overlap integral. Although cations and anions in the melts are partly associated, the NMR shifts of the Tl nucleus show that the cause arises from incipient covalency rather than polarization of the cation by the halide ions. In both the crystalline and molten states, a linear paramagnetic shift with temperature is observed, which is attributed to the enhanced overlap of excited states which are induced by thermal vibrations. (Contractor's abstract)

521

Chicago U. Inst. for the Study of Metals, Ill.

PERTURBATION THEORY OF THE HEATS OF MIXING OF FUSED SALTS, by H. T. Davis and S. A. Rice. [1964] [11]p. (AFOSR-64-2182) (AF AFOSR-61-52) AD 452035   Unclassified

Also published in Jour. Chem. Phys., v. 41: 14-24, July 1, 1964.

A theory of the thermodynamic properties of molten salts including the effects of short-range attractive interactions has been developed. The analysis builds upon the work of Reiss, Katz, and Kleppa who showed that many of the thermodynamic properties of molten salt mixtures could be understood in terms of a model ionic melt consisting of rigid impenetrable ions interacting with a long-range Coulomb potential. The RKK theory is inadequate for the description of recent experimental measurements of the heats of mixing salts whose short-range attractive interactions are expected to be significant. (Contractor's abstract)

522

Chicago U. Inst. for the Study of Metals, Ill.

POLARIZATION CONDUCTIVITY IN P-TYPE GERMANIUM, by S. Golin. [1963] 11p. (AFOSR-64-0429) (AF AFOSR-62-178) AD 436282 Unclassified

Also published in Phys. Rev., v. 132: 178-188, Oct. 1, 1963.

The ac conductivity of p-type Ge was measured over the frequency range of 102 to 105 cps and in the impurity conduction temperature range of $1.2°$ to $4.2°K$. Doping by transmutation insured a constant donor to acceptor concentration ratio of 0.4. (Contractor's abstract)

523

Chicago U. Inst. for the Study of Metals, Ill.

TEMPERATURE DEPENDENCE OF THE ULTRA-SONIC ATTENUATION IN GERMANIUM, by B. I. Miller. [1963] [7]p. (AFOSR-64-1237) (AF AFOSR-62-178) AD 442352 , Unclassified

Also published in Phys. Rev., v. 132: 2477-2483, Dec. 15, 1963.

The ultrasonic attenuation in germanium has been measured as a function of temperature from 300 to $20°K$ and at frequencies of 4 to 132 mc/sec. The measurements were made using the pulse-echo technique with longitudinal sound pulses along the octahedral direction.

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Chicago U. Inst. for the Study of Metals, Ill.

SELF-DIFFUSION OF LIQUID ZINC, by N. H. Nachtrieb, E. Fraga, and C. Wahl. [1963] [3]p. incl. diagr. tables. (AFOSR-64-0440) (AF AFOSR-62-231) AD 435654 Unclassified

Also published in Jour. Phys. Chem., v. 67: 2353-2355, Nov. 1963.

Self-diffusion in liquid zinc has been measured by the open capillary technique over the temperature range 450 to $600°$. The results are described by the equation

$D_{Zn} = 8.2 \times 10^{-4} \exp(-5090/RT)$. Satisfactory agreement with the Cohen-Turnbull free volume theory is found, and the diffusing particle appears to be the Zn^{+2} ion. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

HALL COEFFICIENTS OF LIQUID METALS, by A. J. Greenfield. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0177) (AF AFOSR-63-148) AD 456558 Unclassified

Also published in Phys. Rev., v. 135: A1589-A1595, Sept. 14, 1964.

The Hall coefficients R of 9 liquid metals were accurately measured using an alternating-current-alternating-magnetic-field method. Four of these metals have $R = R_0 \equiv 1/nec$, which is the value predicted by the free-electron model of liquid metals. The Hall coefficients of these metals, in units of 10^{-5} cm^3/C, are Hg, -7.6; Cd, -7.2; Zn, -5.2; and Sn, -4.4. The other 5 metals were found to have $R/R_0 < 1$, with Ga, -3.83; In, -5.3; Tl, -4.8; Pb, -3.7; and Bi, -3.0. The absolute experimental error for Ga is ± 2.5%. The experimental error for all other metals relative to Ga is approximately ± 1.5% except for Pb (± 12%). The free-electron model of liquid metals is discussed. The value of R/R_0 is compared with magnitude of the mean free path. Comparison is also made with the Hall coefficients of other allotropic forms of these metals.

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Chicago U. Inst. for the Study of Metals, Ill.

THEORIES AND MODELS OF ELECTRON BINDING IN SOLUTION, by J. Jortner, S. A. Rice, and E. G. Wilson. 1963, 55p. (AFOSR-64-1050) (AF AFOSR-63-369) AD 441496 Unclassified

Also published in Solutions Metal-Ammoniac Proprietes Physico-Chimiques, June 1963, p. 222-276.

The investigation of the bound and free states of electrons in liquids is of primary interest not only for the understanding of the properties of metal solutions, but also for the elucidation of the electronic structure of irregular systems. This article reviews the current theories of the electronic states of metal solutions and their relation to the properties of electrons in disordered media. The following systems are considered: Solutions of metals in polar solvents, Electrons in polar solvents, Metal-molten salt solutions, Excess electrons in nonpolar liquids. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF DENSE FLUIDS. XVI.

THE IDEAL IONIC MELT, by B. Berne and S. A. Rice.
[1964] [16]p. (AFOSR-64-1525) (AF AFOSR-63-369)
AD 446400   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1347-
1362, Mar. 1, 1964.

A theory is constructed to describe to first order the
properties of a fused salt. The Rice-Allnatt theory
of simple dense fluids is used in conjunction with the
following assumptions: (1) oppositely charged ions are
of nearly equal size and have identical electronic prop-
erties, except for the sign of the charge; (2) a negative
ion is, on the average, surrounded by positive ions and
vice versa; (3) short-range repulsive interactions occur
only between pairs of oppositely charged ions; and (4)
the role of the Coulomb potential makes an insignificant
contribution to the direct dissipation of energy and
momentum. These conditions are taken to define an
ideal ionic melt, and integrodifferential equations for
the singlet and pair distribution functions of this system
are derived. From these there is obtained an expres-
sion for the ion mobility in a weak electric field. This
expression predicts a deviation from the Nernst-
Einstein relation. A recipe for calculating the thermal
conductance and shear viscosity is outlined. Some
comparisons of theory with experiment are made.
(Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

PERTURBATION CALCULATIONS OF MIXED PAIR
CORRELATION FUNCTIONS, by B. A. Lowry, H. T.
Davis, and S. A. Rice. [1964] 5p. (AFOSR-64-1526)
(AF AFOSR-63-369) AD 446401   Unclassified

Also published in Phys. Fluids, v. 7: 402-406,
Mar. 1964.

A perturbation calculation of the change in pair correla-
tion function (relative to some reference system) is pre-
sented for the case when the intermolecular pair po-
tential is altered (relative to the same reference sys-
tem). The analysis is developed in detail for the case
of a very dilute solution of perturbing molecules in a
host dense fluid, but the case of the pure fluid is also
examined. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ROLE OF HARD-CORE COLLISIONS WITH LARGE
ANGLE DEFLECTIONS IN THE KINETIC THEORY OF
DENSE FLUIDS, by B. Berne and P. Gray. [1964]
[8]p. (AFOSR-64-1527) (AF AFOSR-63-369)
AD 446347   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1582-
1589, Mar. 15, 1964.

The validity of the Fokker-Planck equation is discussed
within the framework of Kirkwood's time smoothing
formalism. It is shown that the equation is equivalent

to the Boltzmann equation for a dilute homogeneous sys-
tem in which grazing binary collisions predominate.
Using this as a mathematical prescription, the Rice-
Allnatt equation is modified by replacing the Boltzmann
collision integral by a Fokker-Planck operator, but
leaving the excluded volume term unchanged. The
kinetic and collisional transport coefficients derived
from the modified equation are compared with those
derived from the Chapman-Enskog equation, the Rice-
Allnatt equation, and the Fokker-Planck equation. It
is concluded that the role of the hard core collisions
in the theory is to emphasize the importance of large
angle deflections, which are not important in a dilute
gas. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF DENSE FLUIDS. XV.
SOME COMMENTS ON THE RICE-ALLNATT THEORY,
by B. Berne and S. A. Rice. [1963] [11]p. incl. tables,
refs. (AFOSR-64-1594) (AF AFOSR-63-369)
AD 446528   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1336-
1346, Mar. 1, 1964.

In this paper, it is shown that, within the framework
of the Rice-Allnatt theory of transport phenomena in
simple dense fluids, the cross-correlation functions
of the soft and hard forces are exactly zero. A relation
is found between the soft doublet and soft singlet friction
coefficients, and an approximate theory is developed
for the soft components of the shear viscosity and the
thermal conductivity. The main assumption in this
approximation is that of small step diffusion. The soft
doublet friction coefficient which is derived in the first
part of the paper is then used to calculate values for the
soft force contribution to the viscosity and thermal con-
ductivity. It is shown that the equilibrium properties
of simple liquids are not known with sufficient accuracy
to allow a complete test of the R-A theory, but that the
expressions in this theory seem to be moderately in-
sensitive to the equilibrium properties used. (Con-
tractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF DENSE FLUIDS. XVII.
THE SHEAR VISCOSITY, by B. A. Lowry, S. A. Rice,
and P. Gray. [1964] [11]p. (AFOSR-64-2192)
(AF AFOSR-63-369) AD 452355   Unclassified

Also published in Jour. Chem. Phys., v. 40: 3673-
3683, June 15, 1964.

A theoretical study of the shear viscosity of dense
fluids along with some measurements of the viscosity of
liquid Ar is reported. It was found that the theory of
Rice and Allnatt leads to predictions of the temperature
dependence of the shear viscosity under conditions of
constant volume in good agreement with experiment.
Also, the magnitudes of the predicted shear viscosity

agreed very well at $T = 128\,°K$, $p = 50$ atm and moderately well at $T = 90\,°K$, $p = 1.3$ atm. The importance of obtaining accurate intermolecular pair potentials and pair correlation functions is discussed briefly. (Contractor's abstract)

532

Chicago U. Inst. for the Study of Metals, Ill.

FORBIDDEN ELECTRONIC TRANSITIONS IN XeF_2 AND XeF_4, by E. S. Pysh, J. Jortner, and S. A. Rice. [1963] [15]p. (AFOSR-64-2193) (AF AFOSR-63-369) AD 452254   Unclassified

Also published in Jour. Chem. Phys., v. 40: 2018-2032, Apr. 1, 1964.

Transition strengths have been measured for the weak 2330A band in XeF_2 ($f = 0.002$) and for the two weak bands in XeF_4 at 2280A ($f = 0.009$) and 2580A ($f = 0.003$). To investigate the origins of these weak transitions, the possibilities of vibronic and singlet-triplet transitions in XeF_2 and XeF_4 were examined. Using the Herzberg-Teller theory of vibronic transitions and a molecular orbital treatment of excited electronic states, estimated strengths of the relevant vibronic transitions have been calculated to the $f = 0.001$ for both XeF_2 and XeF_4. The vibronic band in XeF_2 borrows intensity from the symmetry allowed transition at 1580A ($f = 0.45$), while in XeF_4 the major contribution to the vibronic band is from the symmetry allowed transition at 1325A ($f = 0.8$). A temperature dependence of the intensity of the 2330A band in XeF_2 has been observed and found to be less than that predicted by the Herzberg-Teller theory. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

TRIPLET EXCITON BANDS IN AROMATIC CRYSTALS, by J. Katz, J. Jortner and others. [1963] [3]p. (AFOSR-64-2195) (AF AFOSR-63-369) AD 452362   Unclassified

Also published in Jour. Chem. Phys., v. 39: 1897-1899, Oct. 1, 1963.

The purpose of this letter is to present a computation of the factor-group splittings for triplet exciton states in molecular crystals of naphthalene, anthracene, and several polyphenyls. The factor-group splittings are not as small as previously assumed, and are amenable to experimental observation. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE CALCULATION OF THE MOLECULAR FRICTION CONSTANT, by P. Gray and S. A. Rice. [1964] [2]p. (AFOSR-64-2196) (AF AFOSR-63-369) AD 452363   Unclassified

Also published in Jour. Chem. Phys., v. 40. 3671-3672, June 15, 1964.

The use of isotope-separation data to obtain experimental values of the mean-square force acting on a molecule in a liquid and the implications of this data for the theory of self-diffusion are discussed. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE EXCESS ELECTRON AND HOLE BAND STRUCTURES AND CARRIER MOBILITY IN NAPHTHALENE, ANTHRACENE, AND SEVERAL POLYPHENYLS, by J. I. Katz, S. A. Rice and others. [1963] [15]p. (AFOSR-64-2197) (AF AFOSR-63-369) AD 452387   Unclassified

Also published in Jour. Chem. Phys., v. 39: 1683-1697, Oct. 1, 1963.

The excess electron and hole band structures of naphthalene, anthracene, and several polyphenyls have been calculated in the tight binding approximation. In addition the anisotropy and the pressure dependence of the mobility tensor has been calculated in the constant-free-time and the constant-free-path approximations. The molecular wavefunctions were represented in the LCAO approximation using Huckel coefficients with the carbon atomic orbitals represented by the best available Hartree-Fock SCF carbon 2p ground-state function involving a linear combination of four Slater-type functions. By this choice of atomic orbitals, we hope to account properly for the behavior of the wave-function at the large internuclear distances relevant to this problem. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

SOLVENT EFFECTS AND A TEST OF THE THEORY OF HYPOCHROMISM, by M. T. Vala, Jr. and S. A. Rice. [1963] [6]p. (AFOSR-64-2198) (AF AFOSR-63-369) AD 452364   Unclassified

Also published in Jour. Chem. Phys., v. 39: 2348-2353, Nov. 1, 1963.

The hypochromism of the 2600A absorption band of isotactic polystyrene (relative to atactic polystyrene) was examined. There are important solvent effects which modify the magnitude of the hypochromism. The theory of Tinoco and Rhodes does not include explicit solvent interactions and cannot account for all our experiments. For the case of chloroform as solvent, the theory is in (fortuitous) agreement with experiment if calculations are performed carefully and convergence is established (± 10 rings for 2% residual). If the influence of the solvent may be neglected in this case, it may be concluded that the results obtained are consistent with the retention of local structure when isotactic polystyrene passes from the crystalline phase into solution. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

GUEST-HOST INTERACTIONS: AN EXAMINATION OF THE SOLVENT-INDUCED SPECTRAL SHIFT IN A MODEL SYSTEM, by H. Y. Sun, S. A. Rice, and J. Jortner. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0539) (AF AFOSR-63-369) AD 614269
Unclassified

Also published in Jour. Chem. Phys., v. 41: 3779-3786, Dec. 15, 1964.

The effect of a surrounding lattice of He atoms on the manifold of electronic states of the H_2^+ molecule ion is studied. One-center expansions of the molecular wavefunctions are employed, calculated by the Tibbs-Wannier method. The spherically averaged wavefunctions are in good agreement with the known exact solutions. A detailed study of the environmental effect of the He lattice leads to the prediction of a blue shift of the first electronic transition, arising from a delicate balance between changes in the impurity excitation energy, Coulomb, exchange, van der Waals, and 3-center interaction terms. The signs of the various energy changes are rationalized in terms of the overlap charge density. These results are compared with previous treatments of environmental spectral shifts based on continuum models. (Contractor's abstract)

538

Cincinnati U. [Dept. of Chemistry] Ohio.

THE ENERGETICS OF THE COMBINATION OF A PROTON AND HYDRIDE ION, by R. E. Dessy. Final rept. Sept. 1, 1963-Sept. 30, 1964, 11p. incl. diagr. tables. (AFOSR-65-0245) (AF AFOSR-63-417) AD 611152
Unclassified

The rate of addition of the 'Bumgbr' Grignard reagent to benzonitrile was found to be greatly accelerated by the addition of $LiClO_4$ or $(C_4H_9)_4NClO_4$. An investigation of the reaction mechanism leads to the suggestion that the phenomena represents an example of the activation of organometallic compounds by the presence of 'inert salts'. Studies in the area of carbanion stabilities are briefly summarized.

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City U. of New York. Queens Coll., Flushing, N. Y.

THE ADDITION OF KETONES TO SCHIFF BASES, by A. H. Blatt and N. Gross. [1964] 6p. incl. tables. (AFOSR-65-0005) (AF 49(638)796) AD 455942
Unclassified

Also published in Jour. Org. Chem., v. 29: 3306-3311, Nov. 1964.

The uncatalyzed addition of ketones to Schiff bases reported in the literature could not be repeated. The addition of a number of ketones to Schiff bases can be brought about by small amounts of hydrochloric acid

but the reaction is of limited applicability. Probable reasons are given for the limited scope of the addition reaction, some inaccuracies in the earlier literature are corrected, and a brief description of the chemistry of the adducts is presented. (Contractor's abstract)

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[Clemson U. Dept. of Physics, S. C.]

THE EFFECT OF ELASTIC STRAIN ON THE GALVANO-MAGNETIC PROPERTIES OF SEVERAL METALS, by E. P. Stilwell, Jr. and M. J. Skove. Final rept. [1965] [1]p. (AFOSR-65-0561) (AF AFOSR-63-180)
Unclassified

A list is presented of the work accomplished, the publications which have resulted, and the graduate students who have received training under this grant. The titles of the 3 publications are: (1) Elastic Strength of Tin Whiskers in Tensile Tests; (2) Evidence for Specular Reflection in Zinc and Cadmium Whiskers; and (3) The Effect of Elastic Strain on the Electrical Resistance of Copper and Zinc at 4.2°K.

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Colorado State U. [Dept. of Mathematics and Statistics] Fort Collins.

SAMPLE SIZE REQUIRED TO ESTIMATE THE PARAMETER IN THE UNIFORM DENSITY WITHIN d UNITS OF THE TRUE VALUE, by F. A. Graybill and T. L. Connell. [1964] [7]p. incl. tables. (AFOSR-64-1639) (AF AFOSR-63-469) AD 446876
Unclassified

Also published in Jour. Amer. Stat. Assoc., v. 59: 550-556, June 1964.

A two-step procedure is given to find the sample size necessary to estimate the parameter θ in the uniform density within d units of the true value. It is demonstrated that an exact solution for all values of θ does not exist based on the maximum likelihood estimator.

542

Colorado U. [Dept. of Chemistry] Boulder.

BRIDGED POLYCYCLIC COMPOUNDS. XXVI. THE SOLVOLYSIS OF SOME 4-CHLORODIBENZO-BICYCLO 3.2.1 OCTADIENES, by S. J. Cristol and D. D. Tanner. [1964] [5]p. (AFOSR-64-1796) (AF AFOSR-62-79) AD 449065
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3122-3126, Aug. 5, 1964.

The solvolyses of exo- (II) and endo-4-syn-8-dichloro-dibenzobicyclo octadiene and of exo-4-chlorodibenzo-bicyclo octadiene (V) have been studied. Acetolysis of III and V proceeds with good first-order kinetics to give the exo-acetate IV and its dichloro analog, respectively. The acetolysis of II to IV is accompanied by

epimerization to III, involving ion-pair intermediates. Solvolysis of II pivalic acid gives the endo-pivalate. Various carbonium ions are considered as intermediates, and it is concluded that a classical benzylic carbonium ion can accommodate the results.

543

Colorado U. Dept. of Chemistry, Boulder.

RELATIVE STABILITIES OF WEAK HYDROGEN BONDS TO NITROGEN, by P. J. Berkeley, Jr. and M. W. Hanna. [1964] [6]p. incl. diagrs. taoles, refs. (AFOSR-65-0015) (AF AFOSR-63-216) AD 455824
Unclassified

Also published in Jour. Chem. Phys., v. 41: 2530-2535, Oct. 15, 1964.

A semiclassical picture has been proposed to account for the stabilization of the weak hydrogen bonds formed between chloroform and nitrogen bases as the chloroform proton approaches the base, the H-C bond dipole interacts with the electric field produced by the electrical asymmetry of the base resulting in a reduction in the energy of the system. However, this approach is stopped when the exclusion forces become large in the vicinity of the sum of the van der Waals radii of hydrogen plus nitrogen. The electric field also causes polarization of the H-C bonding electrons toward the carbon atom, resulting in some further stabilization and in the reduction in the screening constant of the proton. It would be dangerous, of course, to extrapolate this point of view to shorter hydrogen bonds.

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Colorado U. [Dept. of Physics] Boulder.

MAGNETIC RESONANCE OF Mn^{2+} DOPED LiF CRYSTALS, by T. T. Chang, W. H. Tanttila, and J. S. Wells. [1963] 4p. (AFOSR-65-0171) (AF AFOSR-62-345) AD 456593   Unclassified

Also published in Jour. Chem. Phys., v. 39: 2453-2456, Nov. 1963.

The electron paramagnetic resonance of Mn^{2+} in powdered LiF was observed at x-band and room temperatures for various impurity concentrations. The highest concentration was examined at K-band and low temperatures to obtain additional information regarding the distribution of Mn^{2+} ions which were introduced chemically into the lattice in small amounts. In the highest concentration, the K-band spectra indicate that part of the Mn^{2+} goes into the powder in the form of clusters of Mn and F which are antiferromagnetic at helium temperatures. NMR linewidth measurements on the lithium nuclei at low temperatures are qualitatively explained by the antiferromagnetism. Comparisons between K-band spectra from chemically prepared powdered samples and single crystals grown from the melt indicate that the melt method is unsuitable for obtaining the solid solution required to examine the superhyperfine spectra.

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Colorado U. Dept. of Physics, Boulder.

BEHAVIOR OF THE SCATTERING AMPLITUDE FOR LARGE ANGULAR MOMENTUM, by A. O. Barut and J. Dilley. [1963] [8]p. incl. refs. (AFOSR-64-0540) (AF AFOSR-63-30) AD 442846   Unclassified

Also published in Jour. Math. Phys., v. 4: 1401-1408, Nov. 1963.

Langer's theory on the asymptotic behavior of the solution of differential equations is applied to angular momentum, giving stronger results than were possible hitherto by Born approximation.

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Colorado U. [Dept. of Physics] Boulder.

A SYMMETRY GROUP CONTAINING BOTH THE LORENTZ GROUP AND SU3, by A. O. Barut. Jan. 14, 1964, 3p. (AFOSR-64-1765) (AF AFOSR-63-30) AD 449081   Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 2_-236, Apr. 10, 1964.

The purpose of this note is to present a group which contains the Lorentz group and accounts for other quantum numbers of strong interactions.

547

Colorado U. [Dept. of Physics] Boulder.

NUCLEON AND THE PION-NUCLEON TRAJECTORY DETERMINATION OF THE PION-NUCLEON COUPLING CONSTANT, by A. O. Barut and J. Dilley. Nov. 14, 1963, 4p. (AFOSR-64-1766) (AF AFOSR-63-30) AD 449079   Unclassified

Also published in Phys. Rev., v. 134: B873-B876, May 25, 1964.

The low-energy p-wave pion-nucleon scattering amplitude is represented by a single Regge pole in the direct channel with correct analytical properties. The three parameters of the trajectory at threshold have been determined.

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Colorado U. Dept. of Physics, Boulder.

ON THE COUPLING CONSTANTS OF MASSLESS PARTICLES, by A. O. Barut. [1964] [2]p. (AFOSR-65-0473) (AF AFOSR-63-30) AD 613817
Unclassified

Also published in Phys. Ltrs., v. 10: 356-357, June 15, 1964.

The restrictions imposed on the most general form of

the form factors for massless particle coupling, which in the limit go over to the coupling constants, are given and the universality of the form factors is shown. Only invariance under the proper inhomogeneous Lorentz group is used.

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Colorado U. Dept. of Physics, Boulder.

CONNECTION BETWEEN THE RELATIVISTIC AND NONRELATIVISTIC FORM OF THE NUCLEON-NUCLEON AMPLITUDE, by A. O. Barut and M. Samiullah. [1964] [3]p. (AFOSR-65-0474) (AF AFOSR-63-30) AD 613816   Unclassified

Also published in Phys. Rev., v. 135: B1356-B1358, Sept. 21, 1964.

The connection between the nonrelativistic and the relativistic amplitudes of the nucleon-nucleon scattering is obtained using a 2 component form of the latter. This connection involves simple functions of E and cosθ. It is then possible to translate the analysis of scattering and polarization experiments in terms of 1 set of amplitudes into the other.

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Colorado U. Dept. of Physics, Boulder.

DYNAMICAL SYMMETRY GROUP BASED ON DIRAC EQUATION AND ITS GENERALIZATION TO ELEMENTARY PARTICLES, by A. O. Barut. [1964] [4]p. incl. refs. (AFOSR-65-0475) (AF AFOSR-63-30) AD 614873   Unclassified

Also published in Phys. Rev., v. 135: B839-B842, Aug. 10, 1964.

The dynamical or exact symmetry group of the nonrelativistic Kepler problem, a symmetry group in four dimensions, is generalized to the Dirac equation and further to elementary particles. The former is a 10-parameter group of rank 2 isomorphic to a group in 5 dimensions, the latter a 16-parameter group of rank 4 isomorphic to a group in 6 dimensions. Both groups contain the real Lorentz group and couple the space-time quantum numbers with the internal quantum numbers. The 16-parameter group has a 15-parameter simple subgroup and contains 2 three-dimensional rotation groups, one for ordinary spin and one for isotopic spin. The concept of inhomogeneous dynamical group is introduced. The inhomogeneous group contains 2 new additive quantum numbers to describe the hypercharge and the baryon number and leads to a mass spectrum. The third component of isospin and the new additive quantum numbers commute with all the 6 generators of the Lorentz group. A further generalization leads to a group where all 3 isospin generators commute with the Lorentz group.

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Colorado U. Dept. of Physics, Boulder.

A NOTE ON THE SIGNATURES OF THE DOMINANT REGGE TRAJECTORIES, by Y.-C. Leung. [1964] [8]p. incl. diagr. refs. (AFOSR-65-0476) (AF AFOSR-63-30) AD 614537   Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 865-872, Aug. 1, 1964.

By the requirements of the unitarity condition and the positive definiteness of the imaginary parts of the forward amplitudes, it has been shown that the dominant Regge trajectories of amplitudes that contribute to forward scattering passing through integer values of angular momenta in the interval $0 \le t < 4_\mu{}^2$, where t is the square of the momentum transfer and $4_\mu{}^2$ is the square of the mass of the lowest intermediate state in the t-channel, must have definite signatures. The result is derived for amplitudes satisfying the Mandelstam representation.

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Colorado U. Dept. of Physics, Boulder.

SECONDARY DIFFRACTION PEAKS IN π N AND K-N SCATTERINGS, by A. O. Barut and W. S. Au. [1964] [3]p. incl. diagr. refs. (AFOSR-65-0477) (AF AFOSR-63-30) AD 613818   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 489-491, Oct. 12, 1964.

It is shown that the secondary peaks observed in π-N and K-N scatterings can be explained remarkably well, using even a very small spin-flip amplitude. By using more than one partial wave, even the wiggly structure on the secondary peaks can be explained.

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Colorado U. Dept. of Physics, Boulder.

$I = 0$ PION-PION AMPLITUDE AND σ DI-PION, by A. O. Barut and W. S. Au. [1964] [3]p. incl. diagrs. table, refs. (AFOSR-65-0815) (AF AFOSR-63-30) AD 616216   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 165-167, Aug. 3, 1964.

This note shown that the assumed existence of the ABC enhancement, the s-wave particle, together with the σ di-pion, s-wave resonance at around 400 mev, and unitarity implies that the whole $I = 0$ pion-pion amplitude is almost exactly known up to over 400 mev. The whole amplitude represents an entirely s-wave continuour virtual particle, and therefore the entire trajectory can be used whenever the $I = 0$, 2π system is exchanged.

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Colorado U. Dept. of Physics, Boulder.

COMPLEX LORENTZ GROUP WITH A REAL METRIC: GROUP STRUCTURE, by A. O. Barut. [1964] [5]p. incl. diagr. tables, refs. (AFOSR-66-0459) (AF AFOSR-63-30) AD 630583   Unclassified

Also published in Jour. Math. Phys., v. 5: 1652-1656, Nov. 1964.

In the attempts to connect the Lorentz group and the internal symmetry of fundamental particles, a 16-parameter connected, noncompact group of rank 4 is studied in detail. The subgroup structure, Lie algebra and its complex extension (which is A_3 in Cartan's notation), little groups, the inhomogeneous groups, and the group invariants are discussed.

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Colorado U. [Dept. of Psychology] Boulder.

A MULTIPLE-INDICATOR APPROACH TO ATTITUDE MEASUREMENT, by S. W. Cook and C. Selltiz. [1964] 20p. (AFOSR-64-2257) (AF AFOSR-63-436) AD 452401   Unclassified

Also published in Psychol. Bull., v. 62: 36-55, July 1964.

Most experimental research on attitudes has used crude measuring instruments, relying on aspects of research design and analysis to overcome ambiguities of interpretation permitted by the measuring instrument. This paper examines different types of instruments from the point of view of the kinds of evidence they provide as a basis for assessing attitudes and of the nature of the inferences involved. Five classes of techniques are discussed: (1) measures in which the material from which attitudes are inferred consists of self-reports of beliefs, feelings, behavior, etc., toward an object or class of objects; (2) observed overt behavior toward the object; (3) reactions to or interpretation of partially structured material relevant to the object; (4) performance on objective tasks where functioning may be influenced by dispostion toward an object; and (5) physiological reactions to the object. (Contractor's abstract)

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Colorado U. [Dept. of Psychology] Boulder.

MEASUREMENTS OF ATTITUDE AND ATTITUDE CHANGE, by S. W. Cook. Final rept. Sept. 1, 1964, 43p. incl. refs. (AFOSR-64-2258) (AF AFOSR-63-436) AD 452333   Unclassified

The goal of the project was to make a systematic and comprehensive study of the effect of an attitude upon a variety of responses. Depending upon the outcome of this work, certain responses were chosen as indicators of attitude. These responses were utilized as bases for the construction of attitude measures.

The responses studied and the measures developed were classified in terms of the nature of the evidence they provided and the nature of the inferences drawn from responses to attitude direction and strength. Eight categories of potential measures were explored: (1) Overt behavior twoard the attitudinal object; (2) Interpretation of and reactions to incomplete or ambiguous stimuli; (3) Adequacy of task performance; (4) Judgments of attitudinally relevant materials; (5) Choice of classificatory principles; (6) Perceptual responses; (7) Involunatry physiological responses, and (8) Verbal self-reports. The work carried out in each of these categories is described. (Contractor's abstract)

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Columbia U., New York.

DISPLAY OF SOUND SPECTROGRAPHS IN REAL TIME, by C. M. Harris and W. M. Waite. [1963] [1]p. (AFOSR-J613) (AF AFOSR 62-251) AD 414019   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 729, 1963.

A technique is described for displaying sound spectrographs in real time. The patterns are obtained by scanning the rectified output of a bank of filters and feeding the output into a standard PPI oscilloscope from a radar system. Thus, no specially constructed visual display unit is required. A method of changing the frequency resolution of the patterns so obtained is described. (Contractor's abstract)

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Columbia U. [Columbia Radiation Lab.] New York.

FINE STRUCTURE OF THE 3^2P TERM IN LITHIUM (Abstract), by B. Budick, H. Bucka and others. [1963] [1]p. (AFOSR-5447) (DA 36-039-sc-78330)   Unclassified

A level crossing has been observed in the 3^2P term of atomic lithium at a field of 916(4) G. The signal is a superposition of 4 hyperfine level crossings with a peak-to-peak separation of approximately 2 G. From the relation between the crossing field and the fine structure splitting $\mu_0 H/\Delta W = (g_s + 2g_\ell)/3g_\ell (g_s + g_\ell) = 4/9$, a doublet separation of 0.0961(5) cm^{-1} was deduced. This is 12% lower than the splitting in the corresponding term in hyrodgen, and should be compared with the fine structure interval in the 2^2p term which is 8% lower than in the corresponding hydrogenic term.

559

Columbia U. [Columbia Radiation Lab.] New York.

ON THE DIFFRACTION OF LIGHT BY ULTRASONIC WAVES IN LIQUID MEDIA (Abstract), by H. Z. Cummins, N. Knable and others. [1963] [1]p. (AFOSR-5448) (DA 36-039-sc-78330)   Unclassified

A 6328A He-Ne maser has been used to study the fine structure of the Debye-Sears effect with both traveling and standing ultrasonic waves. The frequency shifts predicted by Raman and Nath for the traveling wave case have been verified to within one part in 10^6. Measurements of several diffraction maxima produced with standing ultrasonic waves have shown that odd order maxima contain fine structure components shifted by odd harmonics of the ultrasonic frequency, while even order maxima contain components shifted by even harmonics in accord with the Raman-Nath theory.

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Columbia U. [Columbia Radiation Lab.] New York.

HIGH FIELD DOUBLE RESONANCE IN THE $(5s5p)^3P_1$ STATE OF CADMIUM (Abstract), by R. Kohler and P. Thaddeus. [1963] [1]p. (AFOSR-5449) (DA 36-039-sc-78330)　　　　　Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, N. Y., Jan. 23-26, 1963.

Also published in Bull. Amer. Phys. Soc., Series II, v. 8: 9, Jan. 23, 1963.

Double resonance in the $(5s5p)^3P_1$ state of the even cadmium isotopes has been observed at a frequency of 24 kmc and a magnetic field near 11,430 G. At this high field value, the $\Delta m = \pm 1$ components of the optical transition lie well outside the resonance line emitted by a lamp, and the $\Delta m = 0$ component alone is observed in resonance fluorescence. Microwave resonance is then detected by a change in the angular distribution, most conveniently at 90°, of the scattered light. Interaction with the neighboring fine structure states of the 5s5p configuration is sufficient to separate the $\Delta m = \pm 1$ transitions by many times their linewidth.

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Columbia U. [Columbia Radiation Lab.] New York.

NUCLEAR SPIN OF 14y. Cd^{113m} (Abstract), by M. N. McDermott, R. Novick and B. W. Perry. [1963] [1]p. (AFOSR-5450) (DA 36-039-sc-78330)　　　　　　　　　　　　　Unclassified

Presented at meeting of the Amer. Phys. Soc., St. Louis, Mo., Mar. 25-28, 1963.

Also published in Bull. Amer. Phys. Soc., Series II, v. 8: 262, Mar. 25, 1963.

The nuclear spin of 14y. Cd^{113m} has been determined to be I = 11/2 by the optical double resonance technique. The $\Delta m_F = \pm 1$, $\Delta F = 0$ transitions have been observed in the F = 11/2 hyperfine level of the 5s5p $^3P_1$ state of Cd^{113m}. The determination is based on the unique field dependence of the low field Zeeman effect in the F = I state. The isotope was produced by an (n, γ) reaction on 99% pure Cd^{112} separated isotope. The 14y. Cd^{113m} was separated from the

stable isotope in the electromagnetic mass separator at Argonne National Laboratory. About 10^{11} radioactive atoms were used in the experiment.

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Columbia U. [Columbia Radiation Lab.] New York.

NUCLEAR MOMENTS OF 14 yr Cd^{113m} (Abstract), by B. Perry, M. McDermott, and R. Novick. [1963] [1]p. (AFOSR-5451) (DA 36-039-sc-78330)　　　　　　　　　　　　　　　Unclassified

The hyperfine structure constants of 14 yr Cd^{113m} have been determined by the optical double resonance studies of the $(5s5p)$ $^3P_1$ state. The magnetic dipole and electric quadrupole coupling constants are, respectively: A = -684.2(7) mc/sec and B = 174.1 (28) mc/sec. The signs of A and B have been determined with circularly polarized light. Neglecting nuclear structure and quadrupole antishielding corrections, the nuclear moments are $\mu = -1.085(10)$ nm, Q = 0.79(8)b. The Cd^{113m} was produced by an (n, γ) reaction on separated Cd^{112}. After irradiation, the Cd^{113m} was separated from the Cd^{112} in the electromagnetic mass separator at the Argonne National Laboratories. Approximately 10^{11} atoms were used in the experiment.

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Columbia U. Columbia Radiation Lab., New York.

STIMULATED TWO-PHOTON DE-EXCITATION OF METASTABLE HYDROGEN AND SINGLY IONIZED HELIUM (Abstract), by I. D. Abella, M. Lipeles, and N. Tolk. [1963] [1]p. (AFOSR-5452) (DA 36-039-sc-78330)　　　　　　　　　　　Unclassified

A calculation has been performed on the quenching effect of a ruby laser beam (λ = 6940A) on the 2S metastable levels in H and He+. In the absence of perturbation, these levels are believed to decay with simultaneous emission of 2 photons. The de-excitation process considered here is the stimulated emission of a red photon accompanied by uv emission, resulting in 3 outgoing quanta. The contribution from the virtual 2P intermediate states to the differential cross-sections (omitting the $1 + \cos^2\theta$ factors) is given in cm^2/sr by $d\sigma(H)/d\Omega = 3.3 \times 10^{-24}$ and $d\sigma(He^+)/d\Omega = 15.2 \times 10^{-24}$. Summation over all the P states and integration over the continuum is expected to reduce these by a factor of less than 4.

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Columbia U. [Columbia Radiation Lab.] New York.

EVIDENCE FOR THE $(1s2s2p)^4P_{5/2}$ STATE OF LITHIUM (Abstract), by P. Feldman and R. Novick. [1963] [1]p. (AFOSR-5456) (DA 36-039-sc-78330)　　　　　　　　　　　　　　　Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, N. Y., Jan. 23-26, 1963.

Also published tn Bull. Amer. Phys. Soc., Sertes II, v. 8: 8, Jan. 23, 1963.

The negative helium ion tr belteved to exist tn the metastable (1s2s2p) $^4P_{5/2}$ state. The carresponding state in an atomtc beam of ltthtum was produced. Pietenpol has estimated the lifetime of the metastable ltthtum atom to be 1. 6 x 10^{-5} sec, and tts energy ts about 55 v. The $^4P_{5/2}$ state can be produced by exchange exctta tion of ground state Lt atoms. Expert-mentally, a neutral ltthium beam was bombarded with low energy electrons and a molybdenum plate located 3 cm from the bombarder was used to detect photons and metastable atoms. A complex excitation curve was observed with thresholds at a few ev and 55 ev. The low energy threshold corresponds to excttation of atomic states of Lt. The magnitude of the 55 ev threshold ts consistent with the estimated lifetime of the $^4P_{5/2}$ state and a production cross-section of the order of 10^{-19} cm^2.

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Columbia U. [Columbia Radiatton Lab.] New York.

HANLE EFFECT IN THE 3^{2}P STATE OF ATOMIC LITHIUM (Abstract), by R. J. Goshen, H. Bucka and others. [1963] [1]p. (AFOSR-5457) (DA 36-039-sc-78330) Unclassified

Presented at meeting of the Amer. Phys. Soc., St. Louis, Mo., Mar. 25-28, 1963.

Also publtshed tn Bull. Amer. Phys. Soc., Series II, v. 8: 262, Mar. 25, 1963.

The zero-fteld level crosstng tn the 3^{2}P state of the ltthtum atom with a stgnal-to-notse of approximately 100:1 was observed. Light from a flow lamp was scattered from a dense atomtc beam and observed at 90° to the tnctdent light. The Hanle effect tn the 2^{2}P state was also studied. On the basis of the known life-ttmes, the ltne widths should be tn the ratio 1:7. A ratio of 1:6 was observed. No special attempt was made to obtain a homogeneous fteld, nor was the field modulation made opttmum for each state. The ultra-violet ltght output was greatest when the rf discharge tn the lamp was maintatned at htgh argon pressure (10 torr), htgh voltage, and 650°C. Stnce the stgnal ts proportional to the product of osctllator strength and denstty of atoms, the a tomtc beam oven had to be kept 100°-150°C hotter for the 3P state than for the 2P. The estimated effective pressure tn the beam was 1μ.

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Columbia U. Columbia Radiatton Lab., New York.

NUCLEAR SPIN AND DIPOLE MOMENT OF Cd^{115} (Abstract), by F. Byron, R. Novick and others. [1963] [1]p. (AFOSR-5458) (DA 36-039-sc-78330) Unclassified

The nuclear sptn, magnetic hyperfine interaction con-stant, and nuclear magnetic moment of 2.3 day Cd^{115}

have been determtned by the optical double resonance technique tn the (5s5p) $^3P_1$ atomic state. The nuclear sptn, I, and magnetic dipole constant, A, are: $I = 1/2$, $A = -4483.7(10)$ mc/sec. Neglecting nuclear structure the magnetic moment ts: $\mu = -0.64694(15)$ μ_N. Thts value exhtbits the same anomalously small stze as the moments of Cd^{111} and Cd^{113}, also $I = 1/2$. The Cd^{115} was produced by an (n, γ) reactton on 90 % Cd^{114}. The Cd^{115} was tdentified from the decay of the resonances over a 6-day pertod, whtch gives a lifetime $\tau = 59(2)$ hr. This is in good agreement with the accepted value of $\tau = 56$ hr.

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Columbia U. Columbia Radiation Lab., New York.

HANLE EFFECT IN EXCITED STATES OF CHROMIUM (Abstract), by H. Bucka, B. Budick, and R. J. Goshen. [1963] [1]p. (AFOSR-5459) (DA 36-039-sc-78330) Unclassifted

Zero field crosstngs are observed in 2 exctted states of the chromtum atom. The states are $^7P_{234}$ of the (3d)^{5}4p and $^7P_{234}$ of the overlapping configuratton (3d)^{4}4s4p. Ltne widths of 2G and 10G were measured for the 2 triplets respectively. Stnce the transitions to the ground state occur at $\sim$ 3590A and 4280A one was able to select each state with appropriate ftlters. A Schuler type hollow cathode lamp served as a source of resonance radiation. Ltght was scattered from an atomic beam and the fluorescence observed at 90° to the tnctdent ltght beam. The atomic beam oven was heated by electron bombardment. Oscillator strengths, deduced from the measured ltne widths, are in good agreement with optical spectroscoptc intenstty measure-ments.

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Columbia U. Columbia Radiation Lab., New York.

LINE-WIDTHS IN MOLECULAR LIGHT SCATTERING (Abstract), by H. Z. Cummins, Y. Yeh and others. [1963] [1]p. (AFOSR-5460) (DA 36-039-sc-78330) Unclassifted

An opttcal maser hcmodyne spectrometer has been used to measure the ltne-width of the Rayletgh compo-nent of ltght scattered by dilute aqueous solutions of large polymer molecules Theoretical ltne-widths are derived from the colltston narrowtng theory of Dicke. The theoretical and expertmental values are compared, and are shown to depend on the molecular diffuston constant. Observations of the angular dependence of ltght scattering have also been carrted out, and are used to determine the molecular stze through the standard Mie theory. Comparison of the results of these 2 measurements may be used to determine the molecular shape in some cases.

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Columbia U. Columbia Radiation Lab., New York.

OBSERVATIONS ON THE $(1s2s2p)^4P_{5/2}$ METASTABLE
STATE IN LITHIUM (Abstract), by P. Feldman and
R. Novick. [1963] [1]p. (AFOSR-5461) (DA 36-039-
sc-78330)   Unclassified

The $(1s2s2p)$ $^4P_{5/2}$ configuration in He⁻ and Li is
metastable against radiation and autoionization via the
Coulomb interaction. Lithium atoms in this state can
be produced by exchange excitation (energy = 56 ev) of
ground state Li atoms. Experimentally, a neutral
lithium beam is bombarded with low energy electrons
and collect ions resulting from the decay of metastable
atoms 3 cm from the source. The excitation function,
production cross-section ($\sigma \sim 10^{-19}$ cm^2) and the life-
time ($\tau = 5.1 \pm 1\mu$ sec) are measured. A theoretical
estimate of the probability of autoionization resulting
from the spin-spin interaction gives a lifetime of $16\,\mu$
sec. The sublevels of the $^4P_{5/2}$ state should have
different lifetimes because of the mixing with the
rapidly autoionizing $^2P_{1/2}$ and $^2P_{3/2}$ states ($\tau \sim 10^{-14}$
sec). Doubly excited metastable states in the other
alkalis may be produced by excitation from the closed
p shell in the (p^6s) configuration to (p^5sd) $^4F_{9/2}$ state.

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Columbia U. [Columbia Radiation Lab.] New York.

EXISTENCE OF METASTABLE AUTOIONIZING
STATES IN THE ALKALI METALS (Abstract), by P.
Feldman and R. Novick. [1963] [1]p. (AFOSR-5462)
(DA 36-039-sc-78330)   Unclassified

Short lived atomic states lying between the first and
second ionization potentials in the alkalis can be pro-
duced by excitation of an electron from the highest
closed shell in the atom. Such states were observed
by Beutler in K, Cs, and Rb by the absorption of
ultraviolet radiation in alkali vapors and in recent
ionization cross-section measurements on K and Rb.
Configurations of doubly excited states exist which
violate the selection rules for autoionization via the
Coulomb operator, and are therefore longer lived.
The simplest case is the $(1s2s2p)$ $^4P_{5/2}$ state in
lithium. Potassium was studied with the same appa-
ratus used for lithium and a metastable autoionizing
state was found at 17 ev with a lifetime $\approx 10^{-4}$ sec.
The production cross section for this state is an order
of magnitude smaller than that for the short-lived
states.

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Columbia U. [Columbia Radiation Lab.] New York.

MEASUREMENT OF RUBIDIUM SPIN-EXCHANGE
CROSS SECTION (Abstract), by P. Davidovits and
N. Knable. [1963] [1]p. (AFOSR-5463) (DA 36-039-
sc-78330)   Unclassified

The cross section for Rb-Rb spin exchange collisions

has been measured in the ground state of Rb^{87} by a
determination of the band width of a ground state hyper-
fine transition. This is the F = 2, $m_f = 0 \to$ F = 1, $m_f =$
0 transition at 6835 mc. The variation of this bandwidth
with temperature is determined using a flask of oriented
rubidium atoms and together with an independent meas-
urement of the rubidium vapor density an exchange
cross section may be computed. The vapor density is
determined by a measurement of the absorption of white
light by the $S_{1/2}$, F = 1 → $P_{3/2}$ 7800A resonance line,
using a high resolution spectrometer, the f value of the
line being known. The value obtained is
$\sigma_{exchange} = 85 \pm 10 \times 10^{-16}$ cm^2.

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Columbia U. [Columbia Radiation Lab.] New York.

LIFETIME OF THE $(1s2s2p)$ $^4P_{5/2}$ STATE OF
LITHIUM (Abstract), by P. Feldman and R. Novick.
[1963] [1]p. (AFOSR-5464) (DA 36-039-sc-78330)
                                             Unclassified

The lifetime of the $(1s2s2p)$ $^4P_{5/2}$ metastable state of
lithium has been measured in a time-of-flight experi-
ment. Atoms in this state are produced by electron
bombardment of a Li atomic beam (excitation threshold
= 55 ev) and are detected through their decay to a
ground state ion and a free electron. The detector is
movable over 3 cm and at its closest is 3 cm from the
center of the source. In determining the lifetime from
the observed decay, the Maxwellian velocity distribution
of atoms in the source and the finite length of the elec-
tron bombarder must be taken into account. The pre-
liminary result of $\tau = 7 \pm 3$ μsec may be compared with
the estimated value of $16\,\mu$ sec.

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Columbia U. Columbia Radiation Lab., New York.

OPTICAL DOUBLE RESONANCE IN RADIOACTIVE
ATOMS: SPIN AND NUCLEAR MOMENTS OF THE
GROUND STATE OF Cd^{109}, by M. N. McDermott and
R. Novick. [1963] [12]p. incl. diagrs. tables, refs.
(AFOSR-J1306) (DA 36-039-sc-78330) Unclassified

Also published in Phys. Rev., v. 131: 707-718,
July 15, 1963.

The optical double-resonance technique has been
employed for the study of the Zeeman effect and hyper-
fine structure of the $(5s5p)$ $^3P_1$ state of 470-day Cd^{109}.
The nuclear spin, I, magnetic hyperfine interaction
constant, A, and quadrupole interaction constant, B,
are: I = 5/2, A = -1, 148.6 $\pm$ 2.0 mc/sec, and B =
1167.3 $\pm$ 2.0 mc/sec. If nuclear structure and quadru-
pole antishielding corrections are neglected, the corre-
sponding nuclear moments are μ = -0.8286(15)μ N and
Q = +0.78(10)b. These values are discussed in terms
of the configuration mixing model of Arima and Horie.
A number of the problems encountered in the application
of the double resonance technique to radioactive atoms
are discussed. The sensitivity of the method is limited

by the shot noise in the instrumentally scattered light. In the case of the present apparatus, Zeeman resonances are detectable with 2×10^6 cadmium atoms in the vapor phase.

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Columbia U. Columbia Radiation Lab., New York.

SPIN, HYPERFINE STRUCTURE, AND NUCLEAR MAGNETIC DIPOLE MOMENT OF O^{15}, by E. D. Commins and H. R. Feldman. [1963] [8]p. incl. diagrs. tables, refs. (AFOSR-J1404) (DA 36-039-sc-78330)
Unclassified

Also published in Phys. Rev., v. 131: 700-707, July 15, 1963.

The nuclear spin and hfs splitting of O^{15} ($\tau_{1/2} = 124$ sec) in the $^3P_2$ atomic ground state have been determined by the atomic beam magnetic resonance method. O^{15} was produced in the reaction $N^{14}(d, n)O^{15}$ by allowing a 5-mev deuteron beam from the Columbia Van de Graaff accelerator to impinge upon a gaseous N_2 target. The radioactive gas flowed continuously from the target chamber into the microwave discharge source of the atomic beam apparatus. A rotating-wheel deposition detector specially suited for short-lived radioactive atoms was used to detect the beam. The spin is found to be 1/2, in agreement with the shell-model prediction. The hfs splitting of O^{15} in the $^3P_2$ state is observed to be 1037.23 ± 0.07 mc/sec. and the nuclear magnetic dipole moment of O^{15} is deduced to be 0.7189 ± 0.0008 n.m. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

THE THEORY OF COLLISION BROADENING IN THE SUDDEN APPROXIMATION, by F. W. Byron, Jr. and H. M. Foley. [1964] [46]p. incl. diagr. tables, refs. (AFOSR-64-1365) (DA 36-039-sc-78330) AD 444467
Unclassified

Also published in Phys. Rev., v. 134: A625-A637, May 4, 1964.

A method is developed for calculating the cross section for line broadening in the limiting case in which important collisions may be considered to occur very rapidly with respect to the periods corresponding to the transitions in question. This method is essentially an extension of the familiar sudden approximation; reference is made throughout to the particular example of optical double resonance only for definiteness and because there are available experimental results for comparison with the theory. Assuming the impact model and considering the case when the energy levels in question are well resolved with respect to their width, an exact expression is found for resonant self-broadening in the usual weak rf field limit of interest in double resonance. For the case of very small oscillator strengths for the optical transition, the resonant broadening becomes sufficiently small so that second-order, intermediate-state processes dominate,

and approximations must be made to effect sums over intermediate states. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

THE SELF-BROADENING OF OPTICAL DOUBLE RESONANCE LINES IN CADMIUM, by F. W. Byron, Jr., M. N. McDermott, and R. Novick. [1964] [46]p. incl. diagrs. refs. (AFOSR-64-1366) (DA 36-039-sc-78330) AD 444468
Unclassified

Also published in Phys. Rev., v. 134: A615-A624, May 4, 1964.

Collision broadening studies have been made of optical double resonance lines in cadmium. The results indicate that the collision frequency is velocity dependent, contrary to the usual theory of resonance self-broadening. This result supports the suggestion that the broadening results from interactions involving a number of intermediate states rather than only the initial and final states of optical transition. (Contractor's abstract, modified)

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Columbia U. Columbia Radiation Lab., New York.

SPIN AND NUCLEAR MOMENTS OF 245-DAY Zn^{65}: REDETERMINATION OF THE hfs OF Zn^{67} AND $\tau(^3P_1)$ OF ZINC, by F. W. Byron, Jr., M. N. McDermott and others. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-64-1579) (DA 36-039-sc-78330) AD 446375
Unclassified

Also published in Phys. Rev., v. 134: A47-A55, Apr. 6, 1964.

The hfs of the (4s4p) $^3P_1$ state of 245-day Zn^{65} and of Zn^{67} has been determined by the optical double-resonance technique. The nuclear spin I and the hfs splittings are: Zn^{65}: $I = 5/2$, $\nu(7/2-5/2) = 1875.475(6)$ mc/sec, $\nu(5/2-3/2) = 1334.123(6)$ mc/sec; Zn^{67}: $\nu(7/2-5/2) = 2111.300(3)$ mc/sec, $\nu(5/2-3/2) = 1551.565(4)$ mc/sec. The hfs coupling constants, corrected to second order for interaction with the $^3P_2$ and $^3P_0$ states are: Zn^{65}: $A(65) = +535.162(2)$ mc/sec, $B(65) = +2.870(5)$ mc/sec; Zn^{67}: $A(67) = +609.086(2)$ mc/sec, $B(67) = -18.782(8)$ mc/sec. The ratio of the Zn^{65} and Zn^{67} quadrupole moments is $Q(65)/Q(67) = -0.1528(3)$. The lifetime of the (4s4p) $^3P_1$ state of zinc was redetermined and found to be $\tau(^3P_1) = 20(2)$ μsec. The result includes a large correction for the effects of wall collisions. The theory of wall broadening of optical double-resonance lines is developed. (Contractor's abstract, modified)

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[Columbia U.] Columbia Radiation Lab., New York.

A STUDY OF THE FREE EVAPORATION OF ALKALI

HALIDE CRYSTALS BY USE OF VELOCITY SELECTED MOLECULAR BEAMS, by P. Kusch. 1964, 11p. (AFOSR-64-2220) (DA 36-039-sc-78330) AD 452524
Unclassified

This paper is a review of work done with students and collaborators in the last few yr; none of it describes new and unpublished work. The experimental techniques that have been used to study the chemical composition of the vapors of the alkali halides will be described and later some data on the composition of vapors as they effuse from an equilibrium enclosure and as they leave a free crystal will be presented. The reader should refer to the original papers for many of the experimental details.

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Columbia U. Columbia Radiation Lab., New York.

MICROWAVE SPECTRUM OF LITHIUM CHLORIDE, by D. R. Lide, Jr., P. Cahill, and L. P. Gold. [1963] 4p. incl. illus. tables, refs. (AFOSR-64-0820) (DA 36-039-sc-90789) AD 438644   Unclassified

Also published in Jour. Chem. Phys., v. 40: 156-159, Jan. 1, 1964.

The rotational transitions $J = 0 \to 1$ in the 3 lowest vibrational states of Li^7Cl^{35} and the 2 lowest vibrational states of Li^7Cl^{37} have been measured at a temperature of $600°-800°C$. The molecular constants (in mc/sec) for Li^7Cl^{35} are: $B_e = 21181.1 \pm 0.1$, $\alpha_e = 240.2 \pm 0.2$, $\gamma_e = 1.2 \pm 0.2$; those for Li^7Cl^{37} are: $B_e = 20989.9 \pm 0.1$, $\alpha_e = 236.9 \pm 0.2$. The internuclear distance is $r_e = 2.02067 \pm 0.00006A$. (The uncertainties represent maximum limits of error.) A combination of the present results with molecular beam electric resonance data yields a dipole moment $\mu_\nu = 7.075 \pm 0.0885$ ($\nu = 1/2$) D for Li^6Cl^{35}. Two-high-temperature microwave spectrometers of new design are described briefly. A tabulation of molecular constants for the complete series of alkali halide molecules is included. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

NOTES ON RESOLUTION IN SCATTERING MEASUREMENTS, by P. Kusch. [1964] [4]p. incl. diagrs. table. (AFOSR-64-0821) (DA 36-039-sc-90789) AD 438645
Unclassified

Also published in Jour. Chem. Phys., v. 40: 1-4, Jan. 1, 1964.

The instrumental factors that determine the resolution of an atomic beam apparatus in the measurement of total scattering cross sections are discussed. A definition of resolution as the minimum scattering angle for which the efficiency of detection of scattering is 50% is proposed. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

LIFETIME AND hfs OF THE $(5s5p)^1P_1$ STATE OF CADMIUM, by A. Lurio and R. Novick. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-64-1371) (DA 36-039-sc-90789) AD 444466   Unclassified

Also published in Phys. Rev., v. 134: A608-A614, May 4, 1964.

The lifetime and hfs of the $(5s5p)$ $^1P_1$ state of cadmium have been measured by the level crossing technique. Coherence narrowing of the zero-field level crossing (Hanle effect) signal has been observed and found to be in agreement with Barrats theory. The lifetime obtained from 2 independent experiments is 1.66 ± 0.05 x 10^{-9} sec. This value is considerably smaller than earlier values. The ratio of this lifetime to the $(5s5p)$ $^3P_1$ state lifetime obtained by Byron et al. is 6.95 ± 0.30 x 10^{-4}, and in good agreement with the results of Filippov and Kuhn. The dipole interaction constant A ($^1P_1$) obtained for Cd^{111} is $|A(^1P_1)| = 186 \pm 4$ mc/sec. This result is compared to that obtained by Heydenburg. Using the present lifetime measurement and the known hfs intervals for the $^3P_2$ and $^3P_1$ states one obtains the theoretical value of this constant A ($^1P_1$) = 152 ± 25 mc/sec. The single electron hfs constants for the $(5s51)$ configuration are tabulated. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

g_J OF THE $(5s5p)$ $^3P_1$ LEVEL OF Cd AND THE $(6s6p)$ $^3P_1$ LEVEL OF Hg BY HIGH-FIELD DOUBLE RESONANCE, by R. Kohler and P. Thaddeus. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-2136) (DA 36-039-sc-90789)   Unclassified

Also published in Phys. Rev., v. 134: A1204-A1209, June 1, 1964.

An optical double resonance experiment at high magnetic fields has determined g_J for the $(5s5p)$ $^3P_1$ level of the even cadmium isotopes to be 1.49 346(13), and g_J for the $(6s6p)$ $^3P_1$ level of the even mercury isotopes to be 1.486094(8). Resonance was observed in all cases at a frequency of exactly 25 Gc/sec, and magnetic fields near 11400 G. At these high fields the Zeeman energy is of the order of 10^{-3} of the fine structure separations of the triplet terms of the (nsnp) configuration, and the $\Delta m = \pm 1$ transitions are split by 9.51(7) G for Cd, and by 2.99(7) G for Hg. This splitting represents several linewidths in the case of Hg, and many linewidths in that of Cd. The average field of the two $\Delta m = \pm 1$ transitions, however, determines g_J to high precision independent of second-order corrections. (Contractor's abstract)

583

Columbia U. Columbia Radiation Lab., New York.

THE COLLISION BROADENING OF DOUBLE
RESONANCE LINE SHAPES (Abstract), by F. W.
Byron, Jr. 1963, 1p. (AFOSR-5012) (AF AFOSR-
62-65) AD 415215　　　　　　　　Unclassified

Investigation, experimentally and theoretically, has
been made of the collision broadening in optical double
resonance. This is a case in which the energy levels
are so closely spaced (10 - 100 mc/sec) that the colli-
sions can be thought of as occurring very rapidly with
respect to the atomic periods involved. Because of
this extreme situation it is possible to obtain an exact
expression for resonant self-broadening. Results
obtained in cadmium, as well as other experiments by
Brossel and his co-workers on zinc and mercury, are
compared with these expressions, and the feasibility
of measuring the effect under the most general circum-
stances is discussed.

584

Columbia U. Columbia Radiation Lab., New York.

LEVEL CROSSINGS IN THE $(5s5p)^3P_1$ STATE OF
RADIOACTIVE Cd^{107} AND Cd^{109}, by P. Thaddeus
and M. N. McDermott. [1963] 5p. incl. illus. diagrs.
tables, refs. (AFOSR-64-0249) (AF AFOSR-62-65)
AD 431082　　　　　　　　Unclassified

Also published in Phys. Rev., v. 132: 1186-1190,
Nov. 1, 1963.

Four level crossings, which obey the selection rule
$\Delta m_F = 2$, have been detected for hyperfine levels in
the $(5s5p)^3P_1$ state of both 6.7-h Cd^{107} and 470-day
Cd^{109} by observing the change in intensity at 90° of the
resonance fluorescence of the 3261A intercombination
line. The hyperfine interaction constants found from
an analysis of the crossing point fields, and corrected
for interaction with the adjacent fine structure states
of the 5s5p multiplet, are $A_{107} = -853.543(6)$ mc/sec,
$B_{107} = -163.279(5)$ mc/sec, $A_{109} = -1148.784(7)$
mc/sec, $B_{109} = -165.143(5)$ mc/sec. The ratios of
the magnetic-dipole moments, and the electric-
quadrupole moments, to within the effect of hyperfine
anomalies, are $\mu_{107}/\mu_{109} = 0.742997(8)$; $Q_{107}/Q_{109} =$
$0.98871(4)$. (Contractor's abstract)

585

Columbia U. Columbia Radiation Lab., New York.

SPIN AND NUCLEAR MOMENTS OF 317-HOUR Cd^{107},
by F. W. Byron, Jr., M. N. McDermott, and R.
Novick. [1963] 5p. incl. illus. diagrs. refs. (AFOSR-
64-0274) (AF AFOSR-62-65) AD 431081
　　　　　　　　Unclassified

Also published in Phys. Rev., v. 132: 1181-1185,
Nov. 1, 1963.

The Zeeman and hyperfine structure of the $(5s5p)^3P_1$
state of 6.7-h Cd^{107} has been determined by optical
double resonance. Positive identification of the isotope
was obtained through the observation of the decay of the
Zeeman resonance signals. The nuclear spin (I) mag-
netic hyperfine-structure coupling constant (A), and the
quadrupole coupling constant (B), are I = 5/2, A $(^3P_1) =$
854.2 ± 1.0 mc/sec, and B $(^3P_1) = -166 \pm 3$ mc/sec.
Neglecting possible hyperfine structure anomalies and
quadrupole shielding effects, the corresponding nuclear
moments are $\mu_{107} = -0.6162(8)$ μ_N and Q_{107} +0.77(10)b.
These moments are compared with the predictions of
the configuration mixing model of Nova, Arima, and
Horie. The ratio of the Cd^{107} and Cd^{109} quadrupole
moments is $Q_{107}/Q_{109} = 0.993(20)$; this result is inde-
pendent of the shielding corrections. (Contractor's
abstract)

586

Columbia U. Columbia Radiation Lab., New York.

SPIN AND NUCLEAR MOMENTS OF 2.3-DAY Cd^{115}
AND OF 43-DAY Cd^{115m}, by M. N. McDermott, R.
Novick and others. [1964] 5p. (AFOSR-64-1122)
(AF AFOSR-62-65) AD 441854　　　　Unclassified

Also published in Phys. Rev., v. 134: B25-B29,
Apr. 13, 1964.

This paper is devoted to the nuclear spins and moments
of the radioactive isotopes of the Group II elements.
(Contractor's abstract)

587

Columbia U. Columbia Radiation Lab., New York.

LEVEL CROSSING DETERMINATION OF THE LIFE-
TIME OF THE τ $(^1P_1)$ AND g_J $(^3P_1)$ IN ZINC AND THE
hfs OF Zn^{65} AND Zn^{67}, by A. Landman and R. Novick.
[1963] 10p. (AFOSR-64-1580) (AF AFOSR-62-65)
AD 446353　　　　　　　　Unclassified

Also published in Phys. Rev., v. 134: A56-A65,
Apr. 6, 1964.

Optical detection of level crossing in stable Zn^{67} and
of 245-day Zn^{65}, using the intercombination line at
3076A, resulted in a precise determination of the ratios
of the dipole and quadrupole hyperfine coupling constants
in each of the isotopes to the Lande g factor. Using
these results and the values of the dipole coupling con-
stant for each isotope, as determined from double
resonance experiments, values were obtained for the
atomic g factor and "isolated" quadrupole interaction
constants.

588

Columbia U. Dept. of Astronomy, New York.

X-RAYS AND TYPE I SUPERNOVA REMNANTS, by
L. Woltjer. [1964] [5]p. incl. diagr. table. refs.
(AFOSR-65-0397) (AF 49(638)1358) AD 612439
Unclassified

Also published in Astrophys. Jour., v. 140: 1309-
1313, Oct. 1, 1964.

Bowyer, Byron, Chubb, and Friedman (Nature, v. 201:
1307, 1964) have observed x-rays from a source that
probably is to be identified with the Crab Nebula. Chiu
and Salpeter (Phys. Rev. Ltrs., v. 12: 413, 1964)
have suggested that these x-rays are thermal radiation
from a neutron star—which then would be the stellar
remnant of the Crab Nebula supernova. Knowledge of
Type I supernova remnants are briefly reviewed and
an alternative possibility is discussed, which may be
of interest since the existence of neutron stars is still
somewhat in doubt. Three Type I supernovae have
been definitely recorded in our galaxy during historical
times: In 1054 (Crab Nebula), in 1572 (Tycho's super-
nova) and in 1604 (Kepler's supernova). Some data on
these supernovae and their radio and optical remnants
are assembled. Most data are self-explanatory. The
interstellar absorptions were estimated from Hiltner's
(Astrophys. Jour. Suppl. No. 24, 1956) data on nearby
O and B stars.

589

Columbia U. [Dept. of Chemistry] New York.

ELECTRON SPIN RESONANCE SPECTRA OF
METHYL-SUBSTITUTED DIHYDROPYRAZINE
CATIONS AND RELATED RADICALS, by B. L. Barton
and G. K. Fraenkel. [1964] 14p. (AFOSR-64-2504)
(AF 49(638)520) AD 453966   Unclassified

Also published in Jour. Chem. Phys., v. 41: 1455-
1468, Sept. 1, 1964.

Electron spin resonance spectra have been obtained
for the cation radicals of dihydropyrazine and its
methyl-substituted derivatives, and of dihydroquin-
oxaline, 2,3-dimethyldihydroquinoxaline, dihydro-
phenazine, and N,N'-dihydro-4,4'-dipyridyl.
(Contractor's abstract)

590

Columbia U. Dept. of Chemistry, New York.

OPTICAL PUMPING AND CHEMICAL REACTIONS,
by R. J. McNeal, R. A. Bernheim and others.
[1964] [6]p. incl. table, refs. (AFOSR-64-1490)
(AF AFOSR-62-228) AD 446351   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1678-
1683, Mar. 15, 1964.

Optical pumping in this paper refers to the orientation
of the angular momenta of atoms and molecules by

light. The phenomenon of spin exchange raises the
possibility of the use of a gas of pumped atoms as a
highly sensitive detector of free radicals. It is shown,
however, that a suitable buffer gas may not have atoms
of high atomic number, and may not be polar or aromatic
and must be extraordinarily inert chemically. Examples
are He, Ne, Ar, H_2, N_2, CH_4, C_2H_6, C_2H_4, and—for
a short time—Co. These highly stable molecules de-
compose into radicals at ordinary temperature only
under irradiation with vacuum ultraviolet photons or
with particles. Optically pumped gases may be useful,
therefore, in studying the reactions involved in vacuum
uv photolyses of simple hydrocarbons. (Contractor's
abstract)

591

Columbia U. Dept. of Chemistry, New York.

SPIN RELAXATION OF OPTICALLY PUMPED
RUBIDIUM ATOMS IN MOLECULAR BUFFER GASES,
by R. J. McNeal. [1964] [10]p. incl. diagrs. table,
refs. (AFOSR-64-1491) (AF AFOSR-62-228)
AD 446143   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1089-
1098, Feb. 15, 1964.

Short spin relaxation times for rubidium atoms, oriented
by optical pumping, have been observed in the presence
of benzene, ammonia, and dimethyl ether buffer gases.
The disorientation cross sections of these gases in
rubidium are obtained from relaxation times measured
in mixtures with molecular nitrogen. The partial pres-
sures of the gases were low compared to the nitrogen
pressures in the mixtures, and the diffusion coefficient
of rubidium in the mixtures was assumed to be the same
as in pure nitrogen. The cross section of CO has also
been obtained from the longer rubidium spin relaxation
time in this gas. The cross sections of ammonia,
dimethyl ether, and benzene are much larger than cross
sections of other molecular buffer gases. A discussion
of the relaxation processes in these gases is given.
The large cross sections of polar gases with appreciable
dipole moments are found to result from an interaction
of the rubidium atoms with the electric field of the
polar molecules during a collision. (Contractor's
abstract, modified)

592

Columbia U. Dept. of Chemistry, New York.

THEORY OF LINE WIDTHS IN ELECTRON SPIN
RESONANCE SPECTRA: MOTION OF METHYL
GROUPS, by J. H. Freed and G. K. Fraenkel. [1964]
[8]p. incl. table, refs. (AFOSR-64-2209) (AF AFOSR-
63-285) AD 452334   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86:
3477-3484, Sept. 5, 1964.

Calculations show that modulation of the methyl-proton
hyperfine splittings by rotational motion of the methyl
groups can cause several interesting line-width effects.
For a single methyl group, the central pair of lines is

predicted to be broader than the outer pair, and if
the rotational motion is fast, so that nonsecular con-
tributions are important, the central lines are non-
Lorentzian in shape. The presence of large secular
line-width effects of this type causes every third line
in the spectra from radicals with either two or four
equivalent methyl groups to be sharp compared to the
other lines. The variation of the widths from line to
line if the motions of the several methyl groups are
uncorrelated with each other is different in detail from
that found if they are interlocked so as to move in a
completely correlated manner. Throughout the calcula-
tions, the line-broadening effects of such important
mechanisms as the anisotropic intramolecular dipolar
and g-tensor interactions were neglected.

593

Columbia U. Dept. of Chemistry, New York.

REINTERPRETATION OF THE ELECTRON SPIN
RESONANCE SPECTRUM OF THE O-XYLENE NEGA-
TIVE ION, by J. R. Bolton. [1964] [3]p. incl. diagrs.
refs. (AFOSR-65-0011) (AF AFOSR-63-285)
AD 455785   Unclassified

Also published in Jour. Chem. Phys., v. 41: 2455-
2457, Oct. 15, 1964.

The electron spin resonance spectrum of the o-xylene
negative ion has been re-examined in view of a dis-
crepancy between one of the previously reported
splitting constants and the predictions of molecular
orbital theory. The splitting constant has been found
to be 1.81 G instead of ~0.2 G. The new values of
the hyperfine splittings reported are in excellent agree-
ment with the predictions of both molecular orbital
and valence bond theory. A technique is described by
which molecules such as O-xylene can be reduced.
(Contractor's abstract)

594

Columbia U. Dept. of Electrical Engineering, New York.

OPTIMAL CONTROL OF DISCRETE SYSTEMS WITH
CONSTRAINED INPUTS, by P. E. Sarachik and G. M.
Kranc. [1964] [19]p. incl. table, refs. (AFOSR-64-
1312) (AF AFOSR-63-284) AD 444267   Unclassified

Also published in Jour. Franklin Inst., v. 277: 237-
255, Mar. 1964.

In this paper the optimal time problem is considered
for discrete systems with multiple inputs and multiple
outputs when each input may be subject to a different
type of constrained in fashion. The method of solution
presented is to imbed the individual input constraints
in a more general overall constraint on the entire input
vector. The solution for the general constraint is
found and from this the optimum inputs for the original
constraint conditions are obtained. It will be noted
that in general the optimal control for discrete systems
is not unique; in such cases the solution given here will
yield that control with minimum constrained quantities
among all the optimum controls. In addition the

approach used here does not require that the system be
normal although the computations will usually become
more complicated for non-normal systems when one or
more inputs are constrained in amplitude. (Contrac-
tor's abstract, modified)

595

Columbia U. [Dept. of Electrical Engineering] New York.

ON THE CONCEPTS OF CONTROLLABILITY AND
OBSERVABILITY OF LINEAR SYSTEMS, by E.
Kreindler and P. E. Sarachik. [1964] [8]p. incl. diagrs.
refs. (AFOSR-64-1313) (AF AFOSR-62-284)
AD 444269   Unclassified

Also published in IEEE Trans. Automatic Control,
v. AC-9: 129-136, Apr. 1964.

The objectives of this paper are to give a self-contained
presentation of the subject of controllability and observa-
bility (concepts due to Kalman) developed in a simple
yet general and rigorous way; to introduce these con-
cepts in terms of the output as well as in terms of the
state; and to point out and illustrate some of the subtle-
ties which exist in the timevarying case. (Contractor's
abstract)

596

Columbia U. [Dept. of Mechanical Engineering] New York.

AN EXPERIMENTAL STUDY OF HEAT TRANSFER
AT HIGH TEMPERATURE DIFFERENCES IN TURBU-
LENT AIR FLOW BETWEEN A ROTATING CYLINDER
AND A STATIONARY CONCENTRIC OUTER CYLINDER,
by G. S. Longobardo and H. G. Elrod. Final rept.
Oct. 1963, 16p. incl. diagrs. (AFOSR-64-0134)
(AF 49(638)1001) AD 429097   Unclassified

Velocity and temperature data were obtained for the
annulus between a rotating inner cylinder and a station-
ary outer cylinder. The data were obtained for air
under circumstances such that appreciable variation of
the transport properties and density would occur in
a turbulent flow. These data make possible a test of
current theories for the behavior of turbulent, variable-
property flow.

597

Columbia U. Dept. of Mechanical Engineering, New York.

PEIERLS STRESS AND CREEP OF A LINEAR CHAIN,
by J. H. Weiner and W. T. Sanders. [1964] [9]p. incl.
diagrs. table, refs. (AFOSR-64-1780) (AF AFOSR-
63-228) AD 449252   Unclassified

Also published in Phys. Rev., v. 134: A1007-A1015,
May 18, 1964.

The Frenkel-Kontorova dislocation model is modified
by replacing the sinusoidal substrate force by one
which is piecewise linear. Exact solutions are found
for the static configuration and for the Peierls stress,

σ_p. Good agreement is found between these values of σ_p and those obtained previously for a 2-dimensional Rosenstock-Newell model. The atoms of the linear chain are then considered in random motion corresponding to thermal equilibrium and under an applied stress $\sigma < \sigma_p$. The time required for motion of the dislocation from one position of stable equilibrium to an adjacent one is computed by means of a rate-theory formulation adapted to the present type of problem in which the positions of all the atoms in the chain are required to vary in passing over the potential barrier. The theoretical transition times for an infinite chain are compared with analog computer results for a 6-atom chain and reasonably good agreement is found. (Contractor's abstract)

598

Columbia U. Dept. of Mechanical Engineering, New York.

DISLOCATION VELOCITIES IN A LINEAR CHAIN, by J. H. Weiner. [1964] [6]p. incl. diagrs. refs. (AFOSR-65-0783) (AF AFOSR-63-228) AD 616215
Unclassified

Also published in Phys. Rev., v. 136: A863-A868, Nov. 2, 1964.

Dislocation velocities as a function of applied stress are computed for a modified Frenkel-Kontorova model. The analysis is approximate in that only localized normal modes of motion (local modes) are considered, and it is found that steady-state velocities are attained because of imperfect transfer of energy between successive local modes. The significant stress parameter for this model is found to be the dynamic Peierls stress σ_{PD} with the property that dislocation motion will be maintained for any stress $\sigma > \sigma_{PD}$, without the aid of thermal motion, upon condition that the dislocation has surmounted one potential barrier while the stress is applied. For the model parameters here considered, $\sigma_{PD} \sim 10^{-2}\sigma_p$, where σ_p is the static Peierls stress. The model calculations show the extreme stress sensitivity of dislocation velocity at low velocities which has been observed experimentally. Finite-difference calculations show that the local-mode approximation gives reasonably good accuracy up to dislocation velocities approximately 0.7 the speed of wave propagation for infinite wave length in the linear chain.

599

Columbia U. [Dept. of Physics] New York.

[RADIO ASTRONOMY AT MILLIMETER WAVE-LENGTHS], by P. Kusch. Final rept. May 1, 1962-Apr. 30, 1963. Apr. 1963, 4p. (AFOSR-5228) (AF AFOSR-62-50) AD 415961 Unclassified

A radiotelescope designed to operate in the M band frequency region (50 kmc - 75 kmc) was constructed on the roof of the Columbia University Physics Building in 1959. This radiotelescope, with its 5-ft parabolic antenna, was used to study atmospheric absorption lines which are members of the O_2 spin reorientation spectrum and which are abundant near 60 kmc. It was also used to study the emission line near 53 kmc produced by the hyperfine splitting of hydrogenic nitrogen ions in the solar corona.

600

Columbia U. Electronics Research Labs., New York.

COST GUIDELINES FOR STUDY CONTRACTORS, by C. Walsh. Oct. 6, 1964, 17p. (Technical rept. no. T-1/306; rept. no. CU-44-64-AF-1113-ERL) (AF 49-(638)1113) AD 612963 Unclassified

The object of this study is to weigh the technical system potential against economic resources in terms of effectiveness per dollar spent. The number and types of systems considered by the various contractors will be substantial. Cost guidelines are thus required to insure that the economic resources are equally measured in all cases. Since the study results will form part of the basis of executive decisions the reported costs should be based on the experience and judgment of the participating contractors, rather than developed from arbitrary rules. The guidelines indicate the areas of substantial interest and seek to elicit supporting data to permit the proper evaluation of the stated costs.

601

Columbia U. [Electronics Research Labs.] New York.

DELAY LINE FILTERS FOR FREQUENCY MULTI-PLIERS, by J. H. Wuorinen, Jr. July 1, 1963, 107p. (Rept. no. TR-T-1-193; CU-20-63-AF-113-ERL) (AF 49(638)1113) AD 439279 Unclassified

The results of a theoretical investigation of the performance of delay line filters are presented. The use of filters built up from electrical delay lines is suggested for applications requiring long frequency multiplier chains with a high degree of phase linearity. A Fourier approach to filter synthesis results in an arbitrary amplitude response with linear phase, but requires an infinite number of delays. A synthesis procedure is presented which is useful when the number of delays is limited. This procedure leads to a straightforward design when applied to the special class of filters for frequency multipliers. (Contractor's abstract)

602

Columbia U. [Electronics Research Labs.] New York.

TIME-OPTIMAL RENDEZVOUS STRATEGIES, by P. A. Meschler. [1963] 5p. incl. diagr. (AFOSR-64-0976) (AF AFOSR-62-144) AD 440151 Unclassified

Presented at Joint Automatic Control Conf., Minneapolis, Minn., June 19-21, 1963.

Also published in IEEE Trans. on Automatic Control, v. AC-8: 279-283, Oct. 1963.

This paper is concerned with the control of 2 distinct nth-order linear systems described in the standard state vector notation. Since both systems are of nth order their state vectors can be placed in the same n-dimensional phase space. A problem is formulated in which it is desired to transfer each system from separate initial states to some undetermined but coincident state (state vector rendezvous). This goal is to be accomplished in minimum time while the input vectors of both systems are amplitude constrained. Complete necessary and sufficient conditions which must be satisfied by time-optimal solutions are developed, and additionally, a technique for computing the optimum controls is given. (Contractor's abstract)

603

Columbia U. [Inst. of Flight Structures] New York.

BUCKLING OF THIN SHELLS UNDER EXTERNAL PRESSURE, by A. E. Armenakas and G. Herrmann. [1963] [16]p. (In cooperation with Northwestern Tech. Inst., Evanston, Ill.) (AFOSR-J1225) (AF 49(638)-430) AD 424360　Unclassified

Also published in Jour. Eng. Mech. Div.; Proc. Amer. Soc. Civil Eng., v. 89: 131-146, June 1963.

Expressions for the buckling value of the external pressure acting on thin cylindrical shells were earlier derived on the basis of various linear bending theories. For certain ranges of shell dimensions, however, these expressions yield substantially differing results. Moreover they do not take into account the effect of the change, during deformation, of the magnitude and direction of the pressure on the magnitude of the buckling load. In this investigation, a bending theory is used in establishing the value of the hydrostatic and constant-directional pressure for buckling; the results are compared with those of previous investigations. Furthermore, simplified but accurate expressions for the buckling pressure that are applicable to any combination of shell dimensions are presented. (Contractor's abstract)

604

Columbia U. [Inst. of Flight Structures] New York.

THERMOELASTIC DISSIPATION IN VIBRATING PLATES, by J. Irsl. [1963] 6p. incl. diagrs. (AFOSR-J1458) (AF 49(638)430)　Unclassified

Presented at Summer Conf. Amer. Soc. Mech. Eng., Appl. Mech. Div., Ithaca, N. Y., June 24-26, 1963.

Also published in Jour. Appl. Mech., v. 30: 1-6, 1963.

The thermal dissipation associated with the natural modes of free vibration of a thermoelastic medium is obtained as an integral formula involving the mode of vibration and the temperature produced in the mode. The integral formula for dissipation is applied to an infinite isotropic plate, and numerical resuts are given for the 3 lowest, real, symmetric branches of the spec-

trum. Finally, it is shown that low-frequency extensional vibrations of plates can be adiabatic or isothermal, depending on whether adiabatic or isothermal boundary conditions are specified on the faces of the plate.

605

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

METHOD OF DETERMINING THE DEGREE OF FREE OSCILLATION OF A RADIALLY HETEROGENEOUS ELASTIC SPHERE, by Y. Sato and T. Usami. [1963] [12]p. incl. diagrs. table. (Contribution no. 535) (AFOSR-5492) (AF AFOSR-62-303)　Unclassified

Also published in Bull. Earthquake Research Inst., v. 41: 331-342, 1963.

A method is proposed which gives a clue to the determination of the degree (m) of the free oscillation of the earth, or the azimuthal characteristic of the origin of disturbance. This method is based on the principle that the series of zero points of the guiding curve of spectrum peaks depends on the degree number m. If a specific spherical surface harmonics with a certain value of m has a series of zero points that conform to the zeros of the guiding curve of the observed spectral peaks, the degree number m is determined.

606

Columbia U. Lamont Geological Observatory, Palisades, N.Y.

NOTE ON FOURIER ANALYSIS, by H. Jeffreys. [1964] [4]p. (Contribution no. 739) (AFOSR-65-2892) (AF AFOSR-62-303) AD 452908　Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1441-1444, Oct. 1964.

In the search for empirical periodicities there is no advantage in carrying out computations except for periods that are submultiples of the length of the record. Coefficients for 4 such periods in the neighborhood of a maximum amplitude will yield by least squares estimates of a true period and its harmonic coefficients with a valid estimate of uncertainty. (Contractor's abstract)

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Columbia U. Lamont Geological Observatory, Palisades, N. Y.

ON THE M_1-COMPONENT OBTAINED BY GRAVIMETRIC TIDAL OBSERVATION (SCREENING OF GRAVITATIONAL FORCES), by I. Nakagawa. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-2893) (AF AFOSR-62-303) AD 624176　Unclassified

Presented at Fifth Internat'l. Symposium on Earth Tides, Brussels (Belgium), June 1964.

Also published in Special Contrib. Geophys. Inst.,
Kyoto U. (Japan), No. 4: 9-17, 1964.

Absorption of gravitational forces has mainly been
investigated during periods of solar eclipse by several
investigators, and it has been established that the ab-
sorption effect of gravitation, if it exists, does not ex-
ceed the noise level. The mass of the earth is larger
than that of the moon and therefore the gravitational
absorption due to the earth's mass itself should be
larger than that due to the moon's mass. In the present
paper, a trial to detect the absorption effect of the lunar
gravitational forces by the earth's mass is described by
using data obtained with an Askania gravimeter No. 111,
installed at Kyoto, during a period of 1 yr. By the
present investigation, it is ascertained that the gravita-
tional absorption due to the earth's mass is about
4 μ/gal and that its value reaches a maximum 2 hr after
the instant when the moon transited the meridian of the
observation station. The value of amplitude obtained
by observation is in good agreement with that predicted
by theoretical calculation. But concerning the phase,
there exists a difference of about 180° compared with
that expected by theoretical calculation.

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Columbia U. Lamont Geological Observatory,
Palisades, N. Y.

THE HINDU KUSH EARTHQUAKE OF MARCH 4,
1949 AS RECORDED IN EUROPE, by I. Lehmann.
[1964] [11]p. (AF AFOSR-62-303) AD 612857
Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
1915-1925, Dec. 1964.

The European records from distances 36° - 50° of the
deep Hindu Kush earthquake of Mar. 4, 1949 were
studied. The many clearly recorded deep-focus re-
flections lend to the records a characteristic appear-
ance which is repeated in many other shocks from the
same focal region. The ratios of the amplitudes of
these phases vary somewhat from one shock to another.
In the shock here considered sP and sPP are excep-
tionally large at most stations; in the Italian stations
they are not so large, while pP is a clear phase, pP
is not very well defined at most other stations. Most
of the 1949 records were from the old type long-period
instruments having their highest magnification for
periods from about 5 to 12 sec. It is shown in examples
that the amplitude ratio PP:P may differ strongly at the
same epicentral distance and also that pP may vary
greatly with azimuth. The deficiency of station readings
is noted. Travel times and their residuals are tabu-
lated and travel times plotted vs epicentral distances.
(Contractor's abstract, modified)

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Columbia U. Lamont Geological Observatory,
Palisades, N. Y.

ON THE TRAVEL TIMES OF P AS DETERMINED

FROM NUCLEAR EXPLOSIONS, by I. Lehmann. [1964]
[17]p. (AF AFOSR-62-303) AD 436046 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
123-139, Feb. 1964.

A study has been made of the travel times of P waves
as recorded from 14 shots on the Nevada Test Site (NTS)
and from the Gnome (GN) shot. The travel times on
different lines extending from the test sites were con-
sidered separately. Of special interest were the travel
times obtained on the line joining the NTS and GN site.
The two sets of travel times were in good agreement,
but from epicentral distance 700 km onwards they
were delayed and scattered. This was an indication
of the presence of a low velocity layer at small depth
on the line. Travel times on lines extending in other
directions from the NTS differed somewhat but not very
greatly from those on the NTS-GN line. (Contractor's
abstract)

610

Columbia U. Lamont Geological Observatory,
Palisades, N. Y.

ON THE VELOCITY OF P IN THE UPPER MANTLE,
by I. Lehmann. [1964] [7]p. incl. diagrs. (AF AFOSR-
62-303) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 54: 1097-
1103, Aug. 1964.

The travel times of P in the upper mantle are considered.
Usually the phases are more clearly recorded at epi-
central distances beyond 15° and here the time-distance
curves have appreciable curvature. At smaller dis-
tances the time-curves are nearly straight lines, that
sometimes are cut off at distances less than 15°.
Travel times have been calculated on various velocity
assumptions so as to agree with the empirically deter-
mined travel times. For the uppermost mantle the
velocity has been taken either to be constant or slightly
increasing down to a depth sufficiently great for the
phases to be recorded, though with small amplitudes, at
least to distances of 15°, or a low velocity layer has
been inserted that cuts off the time-curve at smaller
distances. (Contractor's abstract, modified)

611

Columbia U. Lamont Geological Observatory,
Palisades, N. Y.

SOFT CORE SPECTRUM SPLITTING OF THE
TORSIONAL OSCILLATION OF AN ELASTIC SPHERE
AND RELATED PROBLEMS, by Y. Sato. [1964] [10]p.
(Contribution no. 696) (AF AFOSR-62-303) AD 444020
Unclassified

Also published in Bull. Earthquake Research Inst.,
v. 42: 1-10, 1964.

The torsional oscillation of an earth model consisting
of a homogeneous mantle and a soft homogeneous core
is studied and the following matters are discussed and

proved: (1) When there is a soft core those modes are predominant which have nearly equal frequencies to that of a liquid core model; (2) These modes are very high radial higher modes, and a simple formula that gives the order number of them is presented; (3) Consecutive spectrum lines far stronger than the other ones sometimes have nearly equal amplitudes and frequencies which fact proves to be a kind of spectrum splitting phenomenon; and (4) Depending on the density and rigidity ratios of the core and mantle observable frequency is higher or lower than that of a liquid core model, and there is also a possibility of 2 spectrum peaks having nearly equal amplitudes. This phenomenon will be of use for the determination of the core rigidity by means of the observation of free oscillation periods. (Contractor's abstract)

612

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

TRANSMISSION OF LOVE WAVES IN A HALF-SPACE WITH A SURFACE LAYER WHOSE THICKNESS VARIES HYPERBOLICALLY, by T. Takahashi. [1964] [15]p. incl. diagrs. refs. (Rept. no. C708) (AF AFOSR-62-303) AD 442265   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 611-625, Apr. 1964.

The propagation of Love waves in a layer over a half-space is theoretically studied for cases where the upper or lower boundary of the layer can be represented by a hyperbola. Curvilinear coordinates are used. Approximate solutions of various modes exist. Among the component harmonic waves of a mode, the representative one for each given position can be specified. This explains the position dependancy of phase velocity. The condition of transmission and reflection of Love waves for this model and the case in which one-half of the hyperbola is replaced by a straight line are discussed. (Contractor's abstract)

613

Columbia U. School of Engineering and Applied Science, New York.

ON A GASEOUS NUCLEAR ROCKET WITH MHD VORTEX FUEL CONTAINMENT, by K. O. Kessey and R. A. Gross. Oct. 1963 [36]p. incl. diagrs. tables. (Rept. no. 6) (AFOSR-64-0570) (AF 49(638)1254) AD 436083   Unclassified

The use of a hydromagnetically driven vortex as a means of separating fuel from propellant in a gaseous nuclear rocket is examined for configurations of practical interest. Theoretical limitations are given on radial mass flow rate for steady flow. The simultaneous compatible conditions of electric power, magnetic field strength, fuel-propellant composition (uranium 235 as fuel and hydrogen as propellant) and inelt composition are determined for steady separation in a critical system. Transport properties are estimated

at 1 ev using kinetic theory. Reactor power requirements and thrust produced by several systems are determined. (Contractor's abstract)

614

Columbia U. [School of Engineering and Applied Science] New York.

DYNAMICS OF IONIZING SHOCK WAVES: SHOCKS IN TRANSVERSE MAGNETIC FIELDS, by C. K. Chu. [1964] [9]p. incl. diagrs. refs. (AFOSR-64-2253) (AF 49(638)1254) AD 452384   Unclassified

Also published in Phys. Fluids, v. 7: 1349-1357, Aug. 1964.

Shock waves propagating into a nonionized neutral gas and ionizing it are considered. A transverse magnetic field is assumed. Using a simple ionization model, it is found that the electric field ahead of the shock may not be arbitrarily imposed, but is determined by the shock structure. This fact was already pointed out by Lyubimov; this paper extends Lyubimov's results and puts them on a more convincing mathematical basis. The piston problem is solved for these shocks; it is found that for a given ionization temperature these shocks are pure gas dynamic shocks at low piston speeds, and approach classical hydromagnetic perpendicular shocks at high piston speeds. (Contractor's abstract)

615

Columbia U. School of Engineering and Applied Science, New York.

NORMAL IONIZING SHOCK WAVES. THE EFFECTS OF EQUILIBRIUM, DISSOCIATION AND IONIZATION, by R. Taussig. Aug. 1964, 57p. incl. diagrs. refs. (Rept. no. 14) (AFOSR-65-0034) (AF 49(638)1254) AD 609344   Unclassified

The steady state jump equations are solved numerically for plane, normal ionizing shock waves in an electromagnetic field. These solutions account for the effects of an upstream electric field parallel to the shock plane, and for the effects of dissociation and ionization across the shock front. Specific calculations are presented for diatomic hydrogen at 273 °K and 100 μ pressure Hg with an applied magnetic field of 1.38 webers/m^2 perpendicular to the shock plane. The results are compared to corresponding ideal gas solutions, and basic differences in the downstream hydrodynamic variables between the gas and switch-on type shocks are discussed. Driving currents are computed for a shock wave followed by a current-driven rarefaction wave propagating down an annular shock tube. These computations compare favorably with previous experimental evidence, and confirm numerically analytic results of an approximate nature for hydromagnetic ionizing fronts.

616

Columbia U. [School of Engineering and Applied Science] New York.

GASEOUS NUCLEAR ROCKET WITH MHD VORTEX FUEL CONTAINMENT, by K. O. Kessey and R. A. Gross. [1964] [4]p. incl. diagr. tables, refs. (AFOSR-65-0572) (AF 49(638)1254) AD 614733
Unclassified

Also published in AIAA Jour., v. 2: 1461-1464, Aug. 1964.

One of the major problems in development of a nuclear rocket is the separation of the gaseous fuel from the propellant. In this report some potentialities and limitations of a hydromagnetically driven vortex separation system are examined for a practical nuclear rocket system. The size, flow limitations, composition of the exhaust gas, electrical power, and reactor power required by a hydromagnetic vortex, gaseous nuclear rocket reactor are determined. The simultaneous requirements for nuclear criticality, adequate fuel-propellant separation, input composition to maintain a steady state, and limits on electrical powerplant weight form the crux of an analysis of the system.

617

Columbia U. School of Engineering and Applied Science, New York.

STRONG IONIZING SHOCK WAVES, by R. A. Gross. Oct. 1964, 64p. incl. diagrs. refs. (Rept. no. 15) (AFOSR-65-1315) (AF 49(638)1254) AD 457225
Unclassified

Electromagnetically driven shock waves in hydrogen are theoretically studied for speeds up to relativistic conditions. In the progression from weak to relativistic shock speeds, various physical phenomena affect the shock wave. Dissociation, ionization, and the presence of an upstream electric field cause several important effects for slow (sub Alfvenic speed) normal ionizing shock waves. Switch-on shock behavior is extended to slow ionizing waves. The effect of radiation is investigated for both the optically thick and thin cases. Relativistic shock jump equations are solved for wave speeds approaching the speed of light. Thermonuclear shock solutions are examined. The shock jump equations and the shock tube problem are solved numerically. Wave stability is reviewed and some experimental results are discussed.

618

Columbia U. School of Engineering and Applied Science, New York.

TRANSPORT PROPERTIES OF HYDROGEN, by D. Brezing. Sept. 1964, 71p. incl. diagrs. tables, refs. (Rept. no. 13) (AFOSR-65-1313) (AF 49(638)1254) AD 609345
Unclassified

The transport properties of hydrogen are calculated

for a pressure range from 10^{-6} atm to 10^2 atm, and at temperatures up to 10^6°K. The Boltzmann formalism, which assumes binary collisions in the expressions for the transport properties of gas mixtures, is applied. Theoretical values, supported by experimental data whenever possible, are used for the atom-atom, atom-ion, and atom-electron collision cross sections. The collision integrals for all interactions are computed. Values of viscosity, thermal, and electrical transport coefficients, as well as the thermoelectric coefficients are calculated.

619

Columbia U. [School of Engineering and Applied Science] New York.

DYNAMICS OF IONIZING SHOCK WAVES. I. TRANSVERSE SHOCKS, by C. K. Chu. Jan. 1964, 45p. (Rept. no. 7) (AF 49(638)1254) AD 601110
Unclassified

A simplified mathematical model of ionizing shock waves in a magnetic field is considered. Roughly speaking, these shocks are an intermediate species between gas shocks and hydromagnetic shocks. The gas ahead of the shock will be assumed to be a perfect nonconductor, and that behind to be a perfect conductor. It is stipulated that the conditions be such that there is no precursor ionization. For simplicity, the energy required in the ionization process is ignored. Transverse shocks are also treated, in which the magnetic field is tangential to the shock front and thus transverse to its direction of propagation (in hydromagnetic usage, such shocks are sometimes called perpendicular shocks; they should not be confused with Alfvén discontinuities, which are also sometimes called transverse shocks). The solution of the algebraic jump conditions is also studied. (Contractor's abstract)

620

Columbia U. [School of Engineering and Applied Science] New York.

NORMAL IONIZING SHOCK WAVES, by R. Taussig. July 1964, 57p. (Rept. no. R-12) (AF 49(638)1254) AD 619206
Unclassified

Solutions to the steady-state jump equations are obtained for a normal ionizing shock wave propagating into a nonconducting, quiescent gas in an electromagnetic field. Comparison of these solutions to pure MHD shocks and ordinary gas shocks indicates that ionizing shocks are hybrids having some properties common to both MHD and gas shocks. Some completely novel effects are produced by the upstream electromagnetic field. A modified Rankine-Hugoniot function is derived and used to select physically reasonable shock solutions. Solutions analogous in some respects to detonation-deflagration waves have been found, and the Chapman-Jouguet condition is applied to them. (Contractor's abstract, modified)

621

Columbia U. School of Engineering and Applied Science, New York.

MAGNETOHYDRODYNAMIC ROTATION OF PLASMAS, by K. O. Kessey. 1963, 168p. incl. diagrs. tables, refs. (Rept. no. 1) (AFOSR-5220) (AF AFOSR-63-48) AD 418200   Unclassified

The rotation of an incompressible plasma is analyzed for the case when it is confined in an axisymmetrical cylindrical structure impressed with radial electric and axial magnetic fields. The analyses are concerned with steady and transient, one- and two-dimensional laminar flow of a nonviscous and viscous plasma with either small or very large electrical conductivity. The one-dimensional analysis, referred to as the "Zero Radial Mass Flux" (ZRMF), involves the azimuthal component of velocity only. The two-dimensional analysis, called the "Non-Zero Radial Mass Flux" (NRMF), deals with both the azimuthal and radial components of velocity. On the basis of two physically interesting approximations, the "flat disc" and the "long cylinder," analytical solutions have been obtained for both the steady and unsteady velocity and pressure fields.

622

Columbia U. School of Engineering and Applied Science, New York.

MAGNETOGASDYNAMIC BOUNDARY CONDITIONS AT A CONDUCTING WALL, by T. E. Luzzi, Jr. 1963, 113p. incl. diagrs. refs. (Rept. no. 2) (AFOSR-5221) (AF AFOSR-63-48) AD 418180   Unclassified

Also published in Phys. Fluids, v. 7: 1329-1338, Aug. 1964. (AFOSR-64-2386; AD 452294)

Velocity boundary conditions at a conducting wall have been developed for the continuum magnetogasdynamic equations. The wall is separated from the fully ionized plasma by a Langmuir type sheath. The effect of the sheath on the single fluid plasma boundary conditions are studied. The potential of the wall may be either greater than, or less than, that of the plasma. Boundary conditions have been developed for both cases. For the case where the wall potential is greater than the plasma it is possible to have a slip velocity at the wall where no-slip would occur in an equivalent unionized gas flow.

623

Columbia U. School of Engineering and Applied Science, New York.

MAGNETOHYDRODYNAMIC SPECIES SEPARATION IN A GASEOUS NUCLEAR ROCKET, by R. A. Gross and K. O. Kessey. July 1963, 43p. incl. diagrs. refs. (Rept. no. 4) (AFOSR-5222) (AF AFOSR-63-48) AD 418182   Unclassified

Also published in AIAA Jour., v. 2: 295-301, Feb. 1964. (AFOSR-64-0895; AD 439863)

The possibility of steady flow separation of U-235 from hydrogen by magnetohydrodynamically spinning the fluid in a cylindrical vortex is treated. A gaseous nuclear rocket configuration is described and its model analyzed. The hydromagnetic equations are solved for the velocity distribution, pressure field, concentration of uranium and hydrogen, electrical power required, and dissipation rates as a function of Hartmann number, and radial Reynolds number. Results of gaseous reactor criticality calculations are given for both unshielded and shielded configurations. Some properties of a hydrogen plasma are presented. Potential rocket performance is given and some further technical problems discussed. The technology involved in this rocket concept is complex and little experience is available. However, the results of this analysis are encouraging and the means of attaining a large thrust rocket with very high specific impulse are seen.

624

Columbia U. School of Engineering and Applied Science, New York.

CONTINUUM RADIATION BEHIND A BLAST WAVE, by R. A. Gross. Aug. 1963 [54]p. incl. diagrs. (Rept. no. 5) (AFOSR-5363) (AF AFOSR-63-48) AD 422927
Unclassified

The principal results of idealized blast wave theory are presented and then extended to include the effects of ionization and radiation. The conditions required to maintain blast wave dynamic similarity with radiation are set forth. Electron density and continuum radiation are determined as a function of position behind a blast wave for the plain, cylindrical and spherical cases. (Contractor's abstract)

625

Columbia U. [School of Engineering and Applied Science] New York.

OBLIQUE DETONATION WAVES, by R. A. Gross. [1963] [3]p. (AFOSR-J1013) (AF AFOSR-63-48) AD 417721   Unclassified

Also published in AIAA Jour., v. 1: 1225-1227, May 1963.

The 2-dimensional, steady-flow equations for oblique detonation waves are developed, and solutions for the jump conditions are presented. A proof is presented that the corresponding Chapman-Jouguet condition for oblique detonation waves occurs when the downstream velocity component, normal to the wave, is sonic. (Contractor's abstract)

626

Columbia U. School of Engineering and Applied Science, New York.

DE-ACTIVATION OF NEON METASTABLES BY H_2, by T. C. Marshall. Jan. 1964 [66]p. incl. diagrs. tables, refs. (Rept. no. 6) (AFOSR-64-0571) (AF AFOSR-63-46) AD 436178   Unclassified

Measurements are reported of the total cross section for de-activation of neon metastables by inelastic collisions with hydrogen. Measurements were made by applying the methods of resonance radiation absorption and microwave diagnostics to the afterglow plasma following a weak pulsed discharge in the mixture of neon and hydrogen. The reaction which converts neon metastable energy into light has been analyzed spectroscopically and forms a large fraction of the total de-activating collisions of neon metastables by hydrogen. These results are applied in a discussion of the effects that internal energy balance may have upon such polyatomic collisions. Observations upon dc discharge plasmas have been made and evidence collected to support and extend the above conclusions. (Contractor's abstract, modified)

627

Columbia U. [School of Engineering and Applied Science] New York.

DYNAMICS OF IONIZING SHOCKS (Abstract), by C. K. Chu. [1963] [1]p. (AFOSR-64-0665) (AF AFOSR-63-48)   Unclassified

Presented at meeting of the Amer. Phys. Soc., Cambridge, Mass., Oct. 1963.

Strong shock waves producing large degrees of ionization are studied using a one-dimensional simplified model of an ideal gas, which is nonconducting on the low pressure side and ideally conducting on the high pressure side of the shock. These shocks are properly classified and parametrized, and their properties are investigated. Specifically, the influences on the density and pressure ratios (considered as functions of the shock Mach number) due to the magnetic field strength, the electric field strength, the magnetic field orientation, and the ionization energy, are computed and catalogued. Many properties, not present in either gas-dynamical shocks or classical hydromagnetic shocks, are found and discussed in some detail.

628

Columbia U. [School of Engineering and Applied Science] New York.

ROTATING ELECTRICALLY CONDUCTING FLUIDS IN A LONG CYLINDER, by K. O. Kessey. [1964] [8]p. incl. diagrs. (AFOSR-64-1670) (AF AFOSR-63-43) AD 448285   Unclassified

Also published in AIAA Jour., v. 2: 864-871, May 1964.

A hydromagnetically generated vortex in an incompressible, viscous, cylindrically confined plasma is analyzed. Solutions for steady laminar one- and two-dimensional flow fields are obtained. The two-dimensional flow field involves impressed radial mass flow. The solutions for the pressure of the flow field with impressed radial mass flow are valid for small magnetic Reynolds number only. Results are given which have application to a gaseous nuclear rocket.

629

Commonwealth Scientific and Industrial Research Organization. Div. of Physics, Sydney (Australia).

THERMAL EXPANSION OF SILICA AT LOW TEMPERATURES, by G. K. White. [1964] 6p. (AFOSR-64-1777) (AF AFOSR-62-391) AD 449088   Unclassified

Also published in Cryogenics, Feb. 1964, p. 2-7.

The thermal expansivity of such glasses as pure silica, Vycor, or borosilicate is both negative and large in magnitude compared with expansivity of common crystalline solids such as quartz or copper. There is close agreement between pure vitreous silica and Vycor but the addition of soda and/or lime alters the behavior considerably. The fact that 3% B_2O_3 (in Vycor) has so little effect on the expansion suggests that the change observed in borosilicate is due primarily to the network-filling agents, namely Na_2O, which is present probably to the extent of about 4%. The soda-lime glass contains about 15% Na_2O and 9% CaO, and its expansion differs from the pure silica by much more than does the borosilicate. This soda-lime glass has a small negative expansion coefficient below 14°K. Quartz in the direction parallel to the optic or hexad axis also has a small negative coefficient at these temperatures but its volume coefficient remains positive. (Contractor's abstract)

630

Commonwealth Scientific and Industrial Research Organization. Div. of Physics, Sydney (Australia).

THE THERMAL EXPANSION OF COPPER AT LOW TEMPERATURES, by G. K. White. [1964] 13p. (AFOSR-65-0172) (AF AFOSR-62-391) AD 611968   Unclassified

Also published in Proc. Roy. Soc. (London), v. 280: 72-84, 1964.

The thermal expansion of copper has been determined at temperatures down to 2°K by means of an electrical capacitance technique. By measuring three-terminal capacitances in a ratio-transformer bridge length changes smaller than 10^{-9} cm can be detected in the capacitor-expansion cell. The linear expansion coefficient is given for below 10°K. These terms, identified respectively as electronic (e) and lattice (l) in origin, lead to the following values of the Gruneisen parameter: $\gamma_e = 0.63 \pm 0.06$, $\gamma_l = 1.72 \pm 0.03$ (γ_0). γ_e is compared with a theoretical free-electron value of 2/3, and the low temperature value of γ_e is compared with values of

1.75 to 1.77 calculated from elastic constants. At room temperature γ ($\sim = \gamma_\infty$) is 2.00, so that $\gamma_\infty - \gamma_0 \sim$ = 28, which agrees well with the theoretical estimates of Barron for a close-packed cubic lattice. (Contractor's abstract, modified)

631

Commonwealth Scientific and Industrial Research Organization. Div. of Physics, Sydney (Australia).

THERMAL CONDUCTIVITY AT LOW TEMPERATURE OF NEUTRON-IRRADIATED BeO, by A. W. Pryor, R. J. Tainsh, and G. K. White. [1964] [16]p. incl. diagrs. table, refs. (AFOSR-65-1928) (AF AFOSR-62-391) AD 626892　　　　Unclassified

Also published in Jour. Nuclear Materials, v. 14: 208-223, 1964.

Measurements are reported of the thermal conductivity of polycrystalline BeO in the temperature range 2°-300°K. Samples were measured in the normal state and then after receiving fast neutron doses of 2.0×10^{18} to 2.0×10^{20} nvt. These measurements were undertaken in order to study the phonon scattering from radiation-induced defects. For the unirradiated material the scattering is adequately described by a combination of phonon interaction processes, grain-boundary scattering, and point scattering from impurities of unknown origin. For the irradiated material, it is assumed that the defects consist predominantly of extensive planar clusters, which anneal in the temperature range 900°-1100°C, and of a lower concentration of point defects which anneal below 600°C. The thermal resistance introduced by irradiation begins to saturate at doses of about 5.0×10^{19} nvt owing to multiple scattering from the co-planar clusters. The measurements give an order-of-magnitude confirmation of earlier estimates of the defect concentration. (Contractor's abstract)

632

Communication Research Inst., Miami, Fla.

COMMUNICATION STUDIES ON TURSIOPS TRUNCATUS, by J. C. Lilly. Final annual rept. Mar. 1962-Feb. 1964. Feb. 1, 1964, 4p. (AFOSR-64-0176) (AF AFOSR-61-62) AD 431850
　　　　　　　　　　　　Unclassified

This paper calls attention to the large brain of Tursiops truncatus and comparisons are made of this brain with man's brain. The working hypothesis is proposed that there is a critical absolute brain size below which language, as we know it, is impossible and above which language, as we know it, is possible and even probable. Tursiops has a brain above this critical level soon after birth. Material from two separate research results on human children is cited. One giving the statistical average of the acquisition of the first stages of the basic elements of human speech, the other is the average brain weight at the same age. In each study there were several hundreds of cases. The critical size is shown to be approximately 900 to 1000 grams in the case of the human. Observations by the author on an infant Tursiops show that this animal did not acquire the precise clicking of the adult until its brain reached 1000 grams, measured at autopsy. Such results are suggestive that this species is quite capable of language behavior. The problem then resides in determining whether or not there is a natural language and/or whether Tursiops can acquire an artificial language.

633

Communication Research Inst., Miami, Fla.

AIRBORNE SONIC EMISSIONS OF TURSIOPS TRUNCATUS (M) (Abstract), by J. C. Lilly. [1964] [1]p. (AFOSR-65-1514) (AF AFOSR-63-415)　Unclassified

Presented at Sixty-seventh meeting of the Acoust. Soc. Amer., New York, May 6-9, 1964.

Also published in Jour. Acoust. Soc. Amer., v. 36: 1007, May 1964.

During the first few days in confinement, the usual large underwater sonic repertoire of the dolphin, Tursiops, can be recorded; airborne emissions are rare. During this time, some produce in air sounds usually heard under water, and then become air-silent. After 8 to 24 wks in confinement, the airborne emissions often start. These complex sounds in air are specified by their amplitude patterns, basic repetition rates, frequency spectra, time courses, and relations to underwater sounds produced concurrently and/or alternatively. Some recorded evidence for a degree of apparent time-course coupling of trains of some of these emissions to similar emissions from other sources is presented.

634

Communication Research Inst., Miami, Fla.

COMMUNICATION STUDIES ON TURSIOPS TRUNCATUS, by J. C. Lilly. Final rept. Jan. 1-Nov. 30, 1964. [1964] [3]p. (AFOSR-65-1602) (AF AFOSR-63-415) AD 623814　　　　　　Unclassified

A review is presented of research on the ability of the dolphin Tursiops truncatus to reproduce the sounds of human speech and to respond vocally appropriately to various vocal stimuli by a human. The physical variables used in analysis were the number of sonic bursts in the observer's presentation and the number of sonic bursts in the dolphin's replies; the durations of the individual bursts and the durations of the interburst silences. For tests where the stimulus was a list of from 1 to 10 nonsense syllables, the dolphin replied with the correct number in 82% of the cases. The dolphin voluntarily continued such difficult performance for periods from 12 to 20 min. Such vocal performance is unknown for any other animal except man.

635

Communication Research Inst., Miami, Fla.

ANIMALS IN AQUATIC ENVIRONMENTS: ADAPTA-
TION OF MAMMALS TO THE OCEAN, by J. C. Lilly.
[1964] 7p. incl. diagr. table, refs. (AFOSR-65-2945)
(AF AFOSR-63-415) AD 628408   Unclassified

Also published in Handbook of Physiology Environ-
ment, 1964, p. 741-747.

This report contains the following topics: Origin of
cetaceans; Adaptation; Brain weights vs body length/
body weight relationships; Tursiops truncatus, an ex-
perimental subject; Physiological functions; Respira-
tion and ingestion; Nutrition; Natural vs unnatural ex-
istence; Sleep; Communication; Sonic and ultrasonic
emissions; Language concepts.

636

Cork U. Coll. (Ireland).

RESEARCH ON COMPLEX FUNCTION THEORY,
by P. B. Kennedy. Final technical rept. Sept. 10,
1963, 28p. (AFOSR-J1280) (AF EOAR-61-3)
AD 424053   Unclassified

The Nevanlinna characteristic of the derivative of a
meromorphic function quasi-bounded in the unit circle
is studied; and also a contribution is made towards the
elucidation of the comparison of the characteristic of
an entire function with its maximum modulus. Solu-
tions are given by two of the problems raised by mem-
bers of the Colloquium on Classical Function Theory at
Cornell U., 1961. Finally proofs are given of a theorem
on lacunary Fourier series, improving a result due to
Tomic, and of a theorem on rearrangement of series,
related to a result due to Agnew. (Contractor's
abstract)

637

Cork U. Coll. (Ireland).

LINEAR BOUNDARY-VALUE PROBLEMS. I. THE
TORSION OF AN IRREGULAR POLYGON, by P. M.
Quinlan. June 1963, 31p. incl. diagrs. (Technical
rept. no. 1) (AFOSR-5161) (AF EOAR-62-43)
AD 416348   Unclassified

Presentation is made of a new exact method of solving
linear boundary value problems, of elliptic type, for
regions bounded externally and, possibly, internally
by polygons — problems previously attacked in some
simplified case, by finite-difference and relaxation
methods. The torsion problem is chosen as the most
suitable medium to develop and exhibit the method,
when the boundary conditions do not involve derivatives.
(Contractor's abstract)

638

Cork U. Coll. (Ireland).

NON-LINEAR BENDING OF AN ANNULAR PLATE.
II. INTEGRATION OF REISSNER'S AND VON
KARMAN'S EQUATIONS, by V. G. Hart. June 1963,
44p. (Technical rept. no. 3) (AFOSR-5164) (AF EOAR-
62-43) AD 416364   Unclassified

Concern is with the equilibrium of a thin annular plate
bent out of its initial plane by transverse edge forces.
The results of integrating the governing non-linear dif-
ferential equations of Reissner are compared with the
results of integrating von Karman's equations for this
problem. (Contractor's abstract)

639

Cork U. Coll. (Ireland).

LINEAR BOUNDARY-VALUE PROBLEMS. II. THE
λ-METHOD FOR RECTANGULAR PLATES, by P. M.
Quinlan. July 1963, 42p. incl. diagrs. tables. (Tech-
nical rept. no. 2) (AFOSR-5411) (AF EOAR-62-43)
AD 424063   Unclassified

A comprehensive method of formulating the rectangular
plate problem, under all boundary conditions and a
wide range of loadings, is presented. The particular
integral is obtained as a double Fourier Sine Series,
which is the complete solution when the plate is simply
supported with all edges in the same horizontal plane.
This is summed to a single series and transformed to
a highly convergent series of negative exponentials in
the plate-variables Ui. The necessary calculus for
differentiation and integration is established, from
which the particular slopes, moments and shears follow
whether for concentrated or line loads or loads dis-
tributed uniformly over polygonal regions. By treating
a concentrated moment as a force-pair, this case is
deduced from that of a concentrated load. The neces-
sary complementary functions and the ensuing simul-
taneous equations for all boundary conditions are formu-
lated in a manner suited to programming for an elec-
tronic computer.

640

Cork U. Coll. (Ireland).

LINEAR BOUNDARY-VALUE PROBLEMS. III. THE
λ-METHOD FOR POLYGONAL PLATES, by P. M.
Quinlan. Apr. 1964, 47p. (Scientific rept. no. 1)
(AFOSR-64-1294) (AF EOAR-62-43) AD 603734
                                  Unclassified

Edge-functions and the λ-method for providing a par-
ticular integral or Green's function are combined to
formulate the necessary simultaneous equations govern-
ing the bending of a polygonal plate, with or without
polygonal holes, under a wide range of loadings and
boundary conditions. A particular feature is the de-
velopment of the computer-formula approach, under
which all cases are combined in a single formula com-
plete with the necessary computer indicators.

641

[Cork] U. Coll. (Ireland).

NON-LINEAR BENDING OF AN ANNULAR PLATE BY
TRANSVERSE EDGE FORCES, by V. G. Hart and
D. J. Evans. [1964] [29]p. incl. diagrs. tables.
(AFOSR-65-2043) (AF EOAR-62-43) AD 627464
Unclassified

Also published in Jour. Math. and Phys., v. 43: 275-
303, Dec. 1964.

The problem is considered of the equilibrium of a thin
annular plate bent out of its initial plane by transverse
forces uniformly distributed along the edges. The
Reissner and von Karman equations are solved for the
annulus and for the asymptotic case of a large load or
a very thin plate. Two sets of boundary conditions are
considered in each of which the edges of the plate are
clamped. In one case edge conditions of zero radial
displacement are assumed and in the other the radial
stress is zero. Analytic solutions are found to the
von Karman equations in the form of asymptotic series,
and the resultant estimates of the rapid rates of change
of dependent variables encountered in the boundary
layers are used to assist numerical integration of both
von Karman and Reissner equations on a digital com-
puter. Solutions of both equations are found to be in
considerable agreement. (Contractor's abstract)

642

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

AN EXPERIMENTAL STUDY OF HYPERSONIC LOW-
DENSITY VISCOUS EFFECTS ON A SHARP FLAT
PLATE, by R. J. Vidal, T. C. Golian, and J. A.
Bartz. 1964, 77p. (AF 49(638)952)   Unclassified

Heat transfer and pressure data were obtained with
sharp flat plate models at zero and large angles of
attack in the CAL hypersonic shock tunnel. These high
Mach number data (Mach 14 to 24) extend from the
classical thin boundary layer regime to near-free-
molecule conditions and are discussed within the frame-
work of existing theory. The large angle-of-attack
results verify viscous shock-layer theory and define
the low-density conditions where transport effects at
the shock wave first become important. The data
obtained at zero angle of attack are compared with
theory to define the fluid mechanism that governs the
low-density effects. The strong shock-wave approxima-
tions, the vorticity interaction, and the shock-wave
heating effects are unimportant in this case.

643

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

MAGNETIC SUSCEPTIBILITY OF 2^3S_1 HELIUM
(Abstract), by J. T. McMullan and R. P. Hurst.
[1963] 1p. (AFOSR-5010) (AF AFOSR-63-191)
Unclassified

Using a wave function similar to that developed by

Hylleraas and Undheim the energy and magnetic
susceptibility of the 2^3S_1 state of helium have been com-
puted. In this work up to a total of 35 terms were
considered, of which many were explicitly dependent
on the interelectron distance r_{12}. Since this function
contains two non-linear parameters one can effectively
allow one electron to be in a "1s" type orbital while
the second is in a "2s" type orbital. This results in an
accurate wave function with comparatively few terms.
Thus with only 20 terms we obtain -2.1752278 a. u.
where the experimental results is -2.1752294 a. u.
Finally, it is reasonable to suppose that the computed
magnetic susceptibility is quite good.

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

MAGNETIC SUSCEPTIBILITY OF 2^3S_1 STATE OF
HELIUM AND SOME LIKE IONS, by J. T. McMullan
and R. P. Hurst. [1964] 5p. (Rept. no. CAL-RA-1761-
P) (AFOSR-65-0441) (AF AFOSR-63-191) AD 612457
Unclassified

Also published in Phys. Rev., v. 135: 973-977,
Aug. 17, 1964.

The magnetic susceptibility of the 2^3S_1 state of helium
and some like ions is computed using a thirty-five term
wave function of the type originally proposed by
Hylleraas and Undheim. It is found that it is possible to
obtain highly accurate values for the magnetic suscepti-
bility using this wave function if the parameters are
accurately determined. Finally, an argument is given
which suggests that the magnetic susceptibility obtained
in the present work is accurate to at least five signifi-
cant figures. (Contractor's abstract)

645

[Cornell U. Center for Radiophysics and Space Research,
Ithaca, N. Y.]

INCOHERENT SCATTER OBSERVATIONS OF
TRAVELING IONOSPHERIC DISTURBANCES, by G. D.
Thome. [1964] [3]p. incl. diagrs. (AFOSR-65-2813)
(AF 49(638)1156) AD 628272   Unclassified

Also published in Jour. Geophys. Research, v. 69:
4047-4049, Oct. 1, 1964.

. The incoherent scatter technique is used to study large
scale traveling ionospheric disturbances above Puerto
Rico. Below the F-region maximum the measurements
of disturbance amplitude, period, and direction of phase
progression with time (downward) are consistent with
the bottomside results of other workers. Above the
maximum, however, the surfaces of constant phase
are found to become vertical, disturbance amplitude
becomes less, and the periods become greater. (Con-
tractor's abstract)

646

Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

RADAR BACKSCATTER FROM THE EARTH'S IONOS-PHERE, by W. E. Gordon. [1964] 5p. incl. diagrs. table, refs. (AF 49(638):156)   Unclassified

Published in IEEE Trans. Military Electron, v. MIL-8. July-Oct. 1964.

The role of radar backscatter observations in ionospheric studies is outlined. The theoretical developments are described that form the basis for ground-based measurements of electron density, electron temperature, ion temperature, and ionic composition at ionospheric heights. Observations of the first three parameters have been successful. Observation of the fourth parameter, ionic composition, is a challenging problem and is being attempted.

647

Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

SECULAR CHANGES IN THE SOLAR SYSTEM, by P. Goldreich. Feb. 1963, 74p. (AFOSR-4743) (AF AFOSR-62-191) AD 407165   Unclassified

This report contains the following articles: On the Inclination of Satellite Orbits About an Oblate Precessing Planet; On the Eccentricity of Satellite Orbits in the Solar System; and An Explanation of the Frequent Occurrence of Near-Commensurate Mean Motions in the Solar Systems.

648

Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

THE INTERSTELLAR ABUNDANCE OF THE HYDRO-GEN MOLECULE. I. BASIC PROCESSES, by R. J. Gould and E. E. Salpeter. [1963] 33p. incl. diagr. refs. (AFOSR-4959) (AF AFOSR-62-191) AD 413840   Unclassified

Also published in Astrophys. Jour., v. 138: 393-407, Aug. 15, 1963.

An analysis is given of the various processes which determine the molecular concentration in H I clouds. The most important mechanism for forming molecular hydrogen is association on the surface of the interstellar grains, the characteristic time for conversion to molecular form being about 30 million yr. It is shown that the range of grain temperatures where this recombination reaction is efficient is coincident with the range 5-20°K which is expected to result from the interaction with the interstellar radiation field. It is estimated that the efficiency (recombination coefficient) of the process is between 0.1 and 1. Regarding dissociative processes, photodissociation through the forbidden transition between the two Heitler-London states of the

molecule, previously thought to be most important, is shown to be negligible. Ionization and dissociation of a cloud by random encounters with O and B stars occurs about once every 100 million yr, so that if the grain recombination process is operative a balance results in which the molecular abundance is roughly comparable to the observed atomic concentration. The cooling properties of molecular hydrogen are discussed. (Contractor's abstract)

649

Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

THE INTERSTELLAR ABUNDANCE OF THE HYDRO-GEN MOLECULE. II. GALACTIC ABUNDANCE AND DISTRIBUTION, by R. J. Gould, T. Gold, and E. E. Salpeter. [1963] 18p. incl. diagrs. tables, refs. (AFOSR-64-0054) (AF AFOSR-62-191) AD 430667   Unclassified

Also published in Astrophys. Jour., v. 138: 408-425, Aug. 15, 1963.

Observations of the distribution in space and velocity of gas clouds, together with considerations of dynamical astronomy, suggest that the total mass density near the galactic plane is appreciably higher than the observed density of visible stars and atomic hydrogen gas. The distribution of K giant stars is compatible also with a high density of "invisible" mass, and it is suggested here that this is contributed by molecular hydrogen gas. Radii of Strömgren spheres for O and B stars are evaluated, and the average rates of dissociation and ionization of molecular hydrogen, due to random encounters of gas clouds with bright stars, are calculated. Using the rates for the association of hydrogen molecules on the surfaces of dust grains, calculated in the preceding paper, the mean equilibrium abundance ratio of molecular to atomic hydrogen is calculated. This ratio is found to be almost independent of the height above the galactic plane and to lie in the range 0.1-10. The effect of molecular hydrogen on the harmonic mean temperature of gas clouds is discussed. (Contractor's abstract)

650

Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

THE INTERSTELLAR ABUNDANCE OF THE HYDRO-GEN MOLECULE, by R. J. Gould. Jan. 1961, 226p. (Rept. no. CRSR-120) (AF AFOSR-62-191) AD 414444   Unclassified

This report contains chapters on: Mechanisms for the formulation of molecular hydrogen; Dissociative processes for a static interstellar medium; and Dissociative effects of clouds motions. Also included are 4 appendices: Appendix A: Photodissociation and photoionization; Appendix B: Velocity distribution of H I clouds; Appendix C: Strömgren spheres; and Appendix D: Problem in Brownian motion.

651

Cornell U. [Center for Radiophysics and Space Research]
Ithaca, N. Y.

ACCRETION OF INTERSTELLAR MATTER BY MAS-
SIVE OBJECTS, by E. E. Salpeter. [1964] [5]p.
(AFOSR-65-0104) (AF AFOSR-63-321) AD 455826
Unclassified

Also published in Astrophys. Jour., v. 140: 796-800,
Aug. 15, 1964.

Observations of quasi-stellar radio sources have indi-
cated the existence in the universe of extremely massive
objects of relatively small size. The present note dis-
cusses the possible further growth in mass of a rela-
tively massive object, by means of accretion of inter-
stellar gas onto it, and the accompanying energy re-
lease. Although there is no evidence for (and possibly
some evidence against) quasi-stellar radio sources
occurring inside ordinary galaxies, for the sake of con-
creteness we consider the fate of an object of mass M
$> 10^6$ (masses in solar units throughout) in an ordinary
spiral galaxy somewhat like ours.

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Cornell U. Center for Radiophysics and Space Research,
Ithaca, N. Y.

EQUILIBRIUM MODELS FOR HELIUM-BURNING
STARS. III. SEMI-DEGENERATE STARS OF SMALL
MASS, by J. P. Cox and E. E. Salpeter. [1964] [4]p.
incl. diagrs. tables, refs. (AFOSR-65-0105) (AF
AFOSR-63-321) AD 455738 Unclassified

Also published in Astrophys. Jour., v. 140: 485-498,
Aug. 15, 1964.

Equilibrium models are constructed for pure helium-
burning stars of small mass. Effects of nonrelativistic
electron degeneracy on the equation of state and elec-
tron thermal conduction on the opacity are included in
the calculations. It is found that, for a star of given
mass M, the central temperature attains a maximum
value $T_{c,max}$ when the central density is a few times
lower than that of a zero-temperature white-dwarf star
of the same mass. A lower mass limit M_{min} of about
$0.35 M_\odot$ is derived for pure helium-burning stars.
Properties of helium-burning stars with M near M_{min}
are discussed, as is their evolution toward the white-
dwarf stage. The early evolution of the models away
from the initial helium-burning "main sequence" has
been approximately followed to the stage where the
mass fraction of helium in the convective core has been
reduced to 10%. The models are found to evolve up-
ward roughly along the helium-burning main sequence
itself.

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Cornell U. Center for Radiophysics and Space Research,
Ithaca, N. Y.

EQUILIBRIUM MODELS FOR HELIUM-BURNING

STARS. IV. MASSIVE STARS AND NUCLEAR
ABUNDANCES, by W. Deinzer and E. E. Salpeter.
[1964] [11]p. incl. diagrs. tables. (AFOSR-65-0106)
(AF AFOSR-63-321) AD 455739 Unclassified

Also published in Astrophys. Jour., v. 140: 499-509,
Aug. 15, 1964.

Equilibrium models are constructed for pure helium-
burning stars of large mass M, where radiation pressure
is important. The approach of extremely massive
models to fully convective, polytropes with n = 3 is dis-
cussed. The early evolution of the models from the
initial helium-burning main sequence has been followed
till the mass funct on x_α of helium in the convective
core is 0.02. The abundances of C^{12}, O^{16}, Ne^{20}, and
Mg^{24} as a function of x_α were calculated for different
masses M. The main final products are C and O for
$M \lesssim 4$ (in solar units), O for M ~ 10 to 100, and Mg for
$M \sim 10^3$ to 10^5. The final abundance of Ne is fairly
small for all masses. When x_α is small, the energy
production is largely from (α, γ) reactions, and en-
hancement factors for the rate ϵ (over that for the
triple-alpha reaction alone) are presented.

654

Cornell U. [Center for Radiophysics and Space Research]
Ithaca, N. Y.

THE DIRECTION OF TIME AND THE EQUIVALENCE
OF 'EXPANDING' AND 'CONTRACTING' WORLD-
MODELS, by D. L. Schumacher. [1964] [5]p. (AFOSR-
65-0407) (AF AFOSR-63-321) AD 612232
Unclassified

Also published in Proc. Cambridge Philos. Soc., v. 60:
575-579, 1964.

It is assumed initially that only the increase of entropy
defines locally the sense of advance of time. This
assumption, together with the feature of global cohere....
of statistical processes, which is provided by the cosmic
line-element, imply that there is a unique way of associ-
ating the standards with the cosmic statistical proc-
esses. There is hence a connection between the sense
of divergence of geodesics of fundamental observers
and the cosmic time-sense. This is in keeping with
the unmodified conservation laws of gravitation and the
analogous adiabatic conversation law quite generally
without dependence on the explicit form of the line
element. These remarks correspond exactly to conse-
quences of the 'elliptic' model in the case of de Sitter
space, obtained by entirely separate geometrical con-
siderations. A remark is made with regard to the
irreversibility associated with quantum measurement.

655

Cornell U. Dept. of Biochemistry, Ithaca, N. Y.

RESPIRATION DURING PHOTOSYNTHESIS, by H. V.
Marsh, Jr., J. M. Galmiche, and M. Gibbs. [1964]
[13]p. incl. tables, refs. (AFOSR-65-0359) (AF 49-
(638)798) AD 611732 Unclassified

Also published in Record Chem. Prog., v. 25: 259-271, Dec. 1964.

An attempt has been made to determine the effect of light on the operation of the tricarboxylic acid cycle in a green alga. Scenedesmus obliquus was incubated with acetate-1-C^{14}, acetate-2-C^{14} or pyruvate-3-C^{14}. Citrate, α-ketoglutarate, malate, succinate, and glutamate were isolated and degraded. Asparate was isolated but not degraded. Sufficient cells were used to obtain specific activity values for each compound without the addition of unlabeled carrier. A classical Krebs cycle is present in these cells. While light decreases the amount of acetate and pyruvate from entering the cycle by increasing lipid synthesis, light has no detectable effect on the turnover of the intermediates of the cycle. Acetate apparently entered the cycle exclusively as acetyl-CoA. This compound is apparently a port of entry into the cycle for pyruvate but in the light there is superimposed a carboxylation of pyruvate to malate. The malic acid formed in the light is not in complete equilibrium with other intermediates of the citric acid cycle. The metabolism of aspartic acid differs in the light and dark. Contrary to previous reports, glutamic acid derives solely from the tricarboxylic acid cycle.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

CRITICAL OPALESCENCE OF BINARY MIXTURES: PERFLUOROTRIBUTYLAMINE ISOPENTANE, by P. Debye, D. Caulfield, and J. Bashaw. [1964] [4]p. incl. diagrs. refs. (AFOSR-65-0373) (AF AFOSR-62-12) AD 811930   Unclassified

Also published in Jour. Chem. Phys., v. 41: 3051-3054, Nov. 15, 1964.

Critical opalescence of the binary liquid mixture perfluorotributylamine and isopentane is investigated. By combining light scattering and x-ray scattering measurements, data over a broad range of values of s/λ [$s = 2 \sin(\theta/2)$, λ is wavelength] are obtained. The second moment of the averaged intermolecular pair potential is determined. It is shown how deviations from straight line behavior in plots of reciprocal intensity vs $(s/\lambda)^2$ are determined by the shape of the intermolecular pair potential curve.

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Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

ON THE COEXISTENCE OF LIQUID PHASES IN METAL-AMMONIA SYSTEMS AND SOME SURFACE TENSION STUDIES ON THESE SOLUTIONS ABOVE THEIR CONSOLUTE POINTS, by M. J. Sienko. [1963] 18p. (AFOSR-64-0881) (AF AFOSR-82-218) AD 438673   Unclassified

Also published in Solutions Metal-Ammoniac Properties Physico-Chimiques, June 1963, p. 23-40.

The phase diagrams of metal-NH_3 systems are reviewed with particular attention to the miscibility gap in the

Li, Na, and K systems. The unique character of the parabolic coexistence curves and their implications of long range forces are considered, together with a simple model of electron delocalization. The latter leads to predicted consolute concentrations of 3.9 atomic % M in NH_3, in remarkable agreement with observed values. The course of surface tension vs concentration has been investigated above the consolute temperature. Behavior is salt-like at low concentrations of M in NH_3 and metallic at high. Vestigial traces of the critical phenomena appear in the surface tension curves but, as expected, diminish with increased departure from the critical temperature. (Contractor's abstract)

658

Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

A TWO-STAGE, TWO-CENTER DECARBOXYLATION, by M. J. Goldstein and G. L. Thayer, Jr. [1963] 2p. (AFOSR-64-1791) (AF AFOSR-63-142) AD 449089   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2673-2674, 1963.

Thermal decarboxylation of the α-pyrone-maleic anhydride adduct was chosen for study assuming (a) that this might legitimately be regarded as a Diels-Alder retrogression and (b) that the structural simplicity of the dienophilic fragment might simplify interpretation of the experimental results.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

THE CATION RADICAL OF TETRAKIS(DIMETHYL-AMINO)ETHYLENE, by K. Kuwata and D. H. Geske. [1964] 5p. incl. diagrs. refs. (AFOSR-64-1511) (AF AFOSR-63-188) AD 488115   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 88: 2101-2105, 1964.

Examination of the polarographic behavior of tetrakis(dimethylamino)ethylene (TDE) showed a two-step wave corresponding to oxidation to TDE$^+$ and TDE^{+2}. The cation radical TDE$^+$ was obtained by oxidation of TDE and reduction of TDE^{+2} as well as by the homogeneous reaction of TDE and TDE^{+2}. The electron spin resonance spectrum of TDE$^+$ was obtained. The assigned coupling constants are $a_N = 4.85 \pm 0.01$ (4 equivalent N^{14} nuclei), $a_H = 2.84 \pm 0.01$ (12 equivalent protons), $a_H = 3.28 \pm 0.01$ G (12 equivalent protons). The nitrogen coupling constant is discussed in relation to coupling constants for other nitrogenous cation radicals. Observation of two different methyl proton coupling constants is rationalized in terms of restricted rotation about the C-$N(CH_3)_2$ bond. (Contractor's abstract)

660

Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

ORGANIC ELECTRO-OXIDATIONS, by D. H. Geske.
Final rept. Oct. 31, 1964, 11p. (AFOSR-64-2249)
(AF AFOSR- 63-166)   Unclassified

It was found possible to oxidize picrate ion on a
platinum electrode in acetonitrile solution. A detailed
study of the electrode process was undertaken by means
of voltammetry, chronopotentiometry, and controlled
potential coulometry. An overall reaction process is
proposed which involves a very short-lived picryl radi-
cal that decays by at least two different reactions—the
most predominant of which forms picric acid by nitro-
gen abstraction.

661

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

ON THE RADIAL DISTRIBUTION FUNCTION IN
FLUIDS, by B. Widom. [1964] 4p. (AFOSR-64-1915)
(AF AFOSR-63-324) AD 450330   Unclassified

Also published in Jour. Chem. Phys., v. 41: 74-77,
July 1, 1964.

It is shown that if $g(r)$ is the radial distribution function
and $\varphi(r)$ the pair potential, then the function $F(r) =$
$g(r) \exp[\varphi(r)/kT]-1$ has a number of properties analo-
gous to those of the pair correlation function $G(r) =$
$g(r) -1$ which are known from the Ornstein-Zernike
theory. The integral of $F(r)$ over all space is related
to the fluctuations in a certain well-defined physical
quantity, in the same way that the integral of $G(r)$ is
related to fluctuations in density. The integral of $F(r)$,
furthermore, is shown to be always positive, so that
on the average $g(r)$ exceeds $\exp[-\varphi(r)/kT]$. Finally,
it is shown that if one makes a hypothesis analogous to
one which is familiar in the Ornstein-Zernike theory,
then it follows that the pair correlation function $g(r)$
cannot vanish more rapidly than the pair potential
$\varphi(r)$ as $r \to \infty$. (Contractor's abstract)

662

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

DEGREE OF THE CRITICAL ISOTHERM, by B.
Widom. [1964] 2p. incl. diagr. (AFOSR-65-0108)
(AF AFOSR-63-324) AD 455798   Unclassified

Also published in Jour. Chem. Phys., v. 41: 1633-
1634, Sept. 15, 1964.

An argument is presented which indicates that if g is
the degree of the critical isotherm, d the degree of the
coexistence curve, and f the power of $|T_c - T|^{-1}$ with
which the isothermal compressibility becomes infinite
as the critical point is approached, then $g = 1 + fd$.
The relation of this result to other theoretical and ex-
perimental facts is discussed. (Contractor's abstract)

663

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

OCCUPATION PROBABILITIES IN THE LATTICE GAS,
by J. M. J. Van Leeuwen. [1964] 4p. incl. table.
(AFOSR-65-1116) (AF AFOSR-63-324) AD 620477
                                      Unclassified

Also published in Jour. Chem. Phys., v. 41: 2959-
2962, Nov. 15, 1964.

A lattice-gas model is considered which consists of N
particles distributed among V/ν_0 cells of equal volume
ν_0. A set of relations obtained by Widom for the proba-
bilities f_r that an empty cell is surrounded by r filled
cells is rederived and extended. The consequences of
the relations for the partition function, the correlation
functions, and partially coupled systems are discussed.

664

Cornell U. [Dept. of Engineering Physics] Ithaca, N. Y.

INVESTIGATION OF THE OXIDATION OF COPPER
BY ELECTRON DIFFRACTION, by E. Yoda and B. M.
Siegel. [1963] 4p. (AFOSR-J1573) (AF AFOSR-62-7)
AD 427630   Unclassified

Also published in Jour. Appl. Phys., v. 34: 1512-
1515, May 1963.

The manner in which the oxide phase nucleates and
grows on copper single crystals exposed to oxygen
at a pressure of 1 x 1/100 mm of Hg and at temperatures
between 300 and 400°C has been investigated by reflec-
tion electron diffraction and electron microscopy.
Widely spaced oxide crystallites oriented with the (110)
direction parallel to the (110) direction of the copper
form and continue to grow at these temperatures even
after the removal of the oxygen atmosphere. No poly-
crystalline phase was observed to form under these
conditions, but the intensities of the copper spot pattern
and Kikuchi lines decreased during exposure to oxygen
and partially recovers in intensity during subsequent
heat treatment.

665

Cornell U. [Dept. of Physics] Ithaca, N. Y.

K-BETA EMISSION SPECTRA OF ARGON AND KCl,
by R. D. Deslattes. [1964] [9]p. (AFOSR-64-1741)
(AF 49(638)402) AD 448286   Unclassified

Also published in Phys. Rev., v. 133: A390-A398,
Jan. 20, 1964.

Measurements of the K beta region of argon gas, and
potassium and chloride in KCl are reported. These
spectra were obtained in fluorescence and recorded by
means of a vacuum, two-crystal spectrometer using
calcite crystals. Under high-energy fluorescent excita-
tion, the chlorine spectrum differs only slightly from
that obtained under electron bombardment. Differences

if any in the potassium spectrum are not apparent. The argon spectrum does not seem to have previously examined with sufficient resolution and intensity linearity to allow such comparison. The spectra are discussed together in an attempt to clarify some of the problems associated with the chlorine valence emission band.

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Cornell U. [Dept. of Physics] Ithaca, N. Y.

K-BETA SPECTRA OF ARGON AND KCl. 'I. SATELLITE EXCITATION, by R. D. Deslattes. [1964] 9p. (AFOSR-64-1742) (AF 49(638)402) AD 448288
Unclassified

Also published in Phys. Rev., v. 133: A399-A407, Jan. 20, 1964.

A model for double-vacancy, single-jump satellites was considered for the case of the K-beta spectra of argon, and argon-like ions. The excitation thresholds implied by this model were investigated by quasimonochromatic fluorescence for the K-beta spectrum of chlorine in KCl. Significant alterations in the spectrum, depending on the character of the primary radiation, are reported for this case. From these observations, the initial states for certain of the more prominent spectral features have been identified as belonging to the configuration KM. (Contractor's abstract)

667

Cornell U. [Dept. of Physics] Ithaca, N. Y.

ARGON K ABSORPTION EDGE BY THE COUNTER RESPONSE-METHOD, by H. W. Schnopper. [1964] 2p. (AFOSR-64-2348) (AF 49(638)402) AD 452252
Unclassified

Also published in Phys. Rev., v. 133: A627-A628, Feb. 3, 1964.

The fine structure of the argon K absorption edge has been observed by measuring the response of an argon-filled proportional counter as a function of the incident x-ray energy. It is shown that the response of a thin counter is proportional to the K-shell contribution to the linear absorption coefficient. The fine structure observed in this method is then shown to be the same as is recorded in the conventional absorption method. (Contractor's abstract)

668

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

[NON-ISENTROPIC GAS DYNAMICS]. Final rept. Sept. 1959-Mar. 31, 1963. July 17, 1963, 4p. (AFOSR-5147) (AF 49(638)674) AD 411194
Unclassified

Inviscid boundary layer is studied and its behavior when the flow is characterized by a strong magnetic field. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

[HIGH SPEED AERODYNAMICS WITH REAL GAS EFFECTS] by W. R. Sears. Final rept. May 1, 1962-Apr. 30, 1964. June 15, 1964, 3p. (AFOSR-34-1138) (AF AFOSR-62-201) AD 601730   Unclassified

Summaries are given of researches in the following fields: Magneto-dynamics of high-temperature gases; Gasdynamics of real and chemically reacting gases; and Dynamics of rarefied gases. A bibliography is given of the 15 publications generated under this grant.

670

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

ANALOG STUDIES OF UPSTREAM-INCLINED WAVES IN MAGNETO-GASDYNAMIC FLOW, by L. S. Iwan. Dec. 1963, 39p. (Rept. no. NP-13) (AF AFOSR-62-201) AD 435901; AD 437750   Unclassified

An analog was devised to study two dimensional magneto-gasdynamic flow for the case of aligned magnetic and velocity fields and a perfectly-conducting compressible fluid. The analog consists of stretched elastic sheets in an incompressible fluid. The elastic sheets are analogous to a magnetic field and produce a body force on the fluid when displaced from their equilibrium positions. The differential equations describing the system are the same as the magneto-gasdynamic equations for the case cited, except for the expression for the body force in the momentum equations. Analysis of the analog system reveals striking similarities between the small disturbance propagation characteristics of that system and magneto-gasdynamics. In particular, it is shown that it is possible to simulate the conditions under which forward-inclined disturbance waves are predicted in magneto-gasdynamics flows about bodies. (Contractor's abstract)

671

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

THE DYNAMICAL EQUATIONS OF PARTIALLY IONIZED GASES, by G. D. Brinker. Sept. 1963, 87p. (AF AFOSR-62-201) AD 428797   Unclassified

The dynamical equations for each component of a partially ionized monatomic gas are presented in two forms. These formulations should be most useful in analyzing the effects of ionization in such nonequilibrium regions as plasma oscillation and boundary layers. Using a perturbed Maxwellian distribution to evaluate the collision integrals, the appropriate transfer

equations for the multi-component gas have been given. These transfer equations simplify greatly when the gas is assumed to be very lightly ionized and are reduced to the equations of a single-fluid-with-conduction model. Secondly, the equations for a three-fluid model are derived. In this model the properties of each species are defined in terms of its own motion, and not in terms of the total mass motion as in the one-fluid model. This model provides a useful physical interpretation of Joule heating effects.

672

Dartmouth Coll., Hanover, N. H.

THE PHOTOELECTRIC CROSS SECTIONS OF Sn, Ta AND Au AT 2.62 MEV, by F. Titus. Nov. 1963, 16p. incl. illus. diagr. tables, refs. (AFOSR-J1242) (AF 49(638)634) AD 424314   Unclassified

Also published in Nuclear Phys., v. 69: 179-185, July 1965.

The photoelectric cross sections of Sn, Ta, and Au at 2.62 mev have been measured in terms of the differential Compton scattering cross section at the same energy. The measured cross sections are in barns; 0.11 ± 0.03, 0.47 ± 0.05, and 0.74 ± 0.06 for Sn, Ta, and Au respectively. These cross sections are considerably smaller than those tabulated by Grodstein and also than cross sections extrapolated from the theoretical work of Pratt. (Contractor's abstract)

673

Dartmouth Coll., Hanover, N. H.

ISOTHERMAL FLOW OF SUPERFLUID HELIUM (Abstract), by J. N. Kidder and H. A. Blackstead. [1964] [1]p. (AFOSR-65-0400) (AF AFOSR-63-74) AD 612350
                                    Unclassified

Also published in Bull. Amer. Phys. Soc., Series II, v. 9: 437, 1964.

Measurements have been made of the isothermal, gravitational flow of superfluid helium at 1.09°K in a circular cross section capillary. The capillary is 0.025 cm internal diam and 170 cm long. Flow between 2 concentric reservoirs is induced by mechanical displacement of the fluid in the outer reservoir. The inner reservoir is a microwave resonant cavity. The pressure gradient and the fluid velocity are calculated from the cavity resonant frequency and the geometry of the system. The pressure gradient along the capillary varied from 1 to 5×10^{-3} dy/cm^3 during the flow measurements, the latter value representing the limit of resolution of the apparatus. The fluid velocity extrapolated to zero pressure gradient is 1 cm/sec, which is interpreted as the superfluid critical velocity. The normal fluid component of the liquid is assumed to be flowing as well as the superfluid, but the observed pressure gradients are too small to be caused by laminar viscous flow at the observed velocities. The pressure gradient has a non-linear dependence on the fluid velocity, for velocities greater than the critical value, similar to that of ordinary turbulent flow, but the calculated Reynolds number indicates that this cannot be turbulence in the normal fluid.

674

Dartmouth Coll., Hanover, N. H.

[FUNCTIONAL ANALYSIS AND PROBABILITY THEORY], by E. Albert, D. R. Ostberg, and W. E.

Ritter. Final technical rept. Oct. 1, 1962 - Sept. 30, 1963. Nov. 1963, 6p. (AFOSR-J1351) (AF AFOSR-63-126) AD 428455   Unclassified

A brief description of the research to be done under this contract by the participating members is given. No technical information is contained in the document.

675

Delaware U. [Dept. of Electrical Engineering] Newark.

PHOTOEMISSION STATISTICS FOR NARROWBAND SIGNALS, by L. P. Bolgiano, Jr. [1964] 5p. (AFOSR-64-2506) (AF AFOSR-63-2) AD 453743
                                    Unclassified

Also published in Proc. Third Internat'l. Cong. on Quantum Electronics, Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 1: 187-191, 1964.

A photoelectron probability distribution, with a variance which could be interpreted as simultaneously representing both wave and particle fluctuations, was computed by Mandel by associating photons stochastically with Gaussian random waves. This probability distribution for the number of photoelectrons ejected by a random signal of limited bandwidth has the form of the distribution giving the number of indistinguishable Bose-Einstein particles to be found in a limited region of phase space at thermal equilibrium. A derivation is given which leads to Mandel's distribution as a general probability distribution for the number of occurrences of a discrete event which reoccurs randomly in time. The Poisson distribution is a limiting form of Mandel's distribution. Because the Poisson distribution is the more familiar distribution, it helps explain the derivation by reviewing a popular derivation leading to the Poisson distribution, with a view towards considering how the derivation might be modified so as to take into account the impossibility of measuring rapid electromagnetic signal variations without using adequately wide bandwidths. (Contractor's abstract)

676

Delaware U. Dept. of Electrical Engineering, Newark.

COMMUNICATION CHARACTERISTICS OF PHOTO-ELECTRIC DETECTION, by J. H. Deal, Jr. Master's thesis. June 1964, 68p. (Technical rept.) (Rept. no. TR-Q41) (AFOSR-65-0027) (AF AFOSR-63-2) AD 628546   Unclassified

The probabilistic nature of the photoelectric conversion process augments other sources of noise in limiting the precision with which electromagnetic signals may be measured with a photoelectric detector. This report develops procedures for considering this added uncertainty in signal measurements of interest for radio type communication at optical frequencies. A probabilistic model of an ideal photodetector is used, in conjunction with the classical wave theory of thermal noise, to compute uncertainties associated with the lack of predictibility inherent in both photoelectric conversion and

thermal processes. It is shown how the uncertainty in the detector output may be characterized by a signal-to-noise ratio, and also how decision criteria for signal detection may be based on the probability functions which characterize the detector output. (Contractor's abstract)

677

Delaware U. Dept. of Electrical Engineering, Newark.

QUANTUM LIMITATIONS TO ELECTROMAGNETIC SIGNAL MEASUREMENTS, by L. P. Bolgiano, Jr. Final rept. Jan. 1, 1963 - Dec. 31, 1964, 14p. (AFOSR-65-0028) (AF AFOSR-63-2) AD 610422
Unclassified

It was found possible to develop a mathematical theory of communication which includes quantum effects, and as is also important, reduces to the mathematics of classical communication theory when quantum effects can be neglected. Because photoelectric detection is used universally at optical frequencies, and because it lends itself to a simpler theoretical description, earlier publications have considered the statistics of photo detection - how they differ for coherent and incoherent signals, and the consequences of these differences for information transmission. The work was concentrated in two major areas: (1) Statistics of Photodetection, and (2) Quantum Statistical Analysis of Communication.

678

Delaware U. [Dept. of Psychology] Newark.

INDIVIDUATION AND SOCIALIZATION—A THEORY OF ASSIMILATION IN LARGE ORGANIZATIONS, by R. C. Ziller. [1964] 20p. (AFOSR-65-0071) (AF AFOSR-62-95) AD 455659
Unclassified

Also published in Human Relations, v. 17: 341-360, 1964.

In this paper, the origins of the need for independence-dependence in a social setting are examined in terms of the more basic need for ego identity. The consequences of the need for ego identity in terms of social behavior are explored, related theories are re-examined on the basis of this developing framework, and the implications of the framework are projected to a number of social problems but particularly the problem of the socialization process in large organizations. (Contractor's abstract)

679

Documentation Inc., Bethesda, Md.

MANAGEMENT CONTROL DATA SYSTEM OF THE U.S. AIR FORCE OFFICE OF SCIENTIF SEARCH. Final technical rept. Nov. 1963, 48p. (.-64-0109) (AF 49(638)1212) AD 430142   Unclassified

MCDS is a centralized, automated total system designed

to fulfill the information requirements of the U. S. Air Force Office of Scientific Research in the management of basic research. The scope of the system covers: (1) control of all proposal data from the time of receipt until a specific action completes the proposal phase; (2) the procurement cycle which is initiated upon the acceptance of a proposal; (3) the storage of all obligated purchase actions in a Historical file from beginning to completion of a research effort; and (4) a completed file which is a repository for all completed research investigations which are not a function of the active program. The purpose of this research was to analyze the needs of AFOSR's management personnel and to develop a comprehensive system which would furnish the output requirements of AFOSR management. (Contractor's abstract)

680

Dublin U. Trinity Coll. (Ireland).

THE EFFECT OF MECHANICAL VIBRATION ON THE BREAK-UP OF A CYLINDRICAL WATER JET IN AIR, by L. Crane, S. Birch, and P. D. McCormack. [1964] 10p. incl. illus. diagrs. refs. (AFOSR-64-1890) (AF EOAR-63-76) AD 450003   Unclassified

Also published in Brit. Jour. Appl. Phys., v. 15: 743-751, 1964.

An account of experimental investigation into the effects of high amplitude high frequency mechanical vibration on the break-up characteristics of a liquid jet in air is given. The main phenomenon of imposed periodicity of drop spacing and uniformity of drop size is described, along with several other interesting phenomena. Graphical relationships between parameters such as vibration frequency, amplitude and break-up length are established. While the results largely confirm Rayleigh's original linear analysis with respect to the wavelength of maximum instability, considerable discrepancy is revealed in the magnitude of the amplification factor and considerable departure from linearity is indicated. (Contractor's abstract)

681

Dublin U. Coll. (Ireland).

FLUX LIMITS FOR HIGH-ENERGY γ-RAYS FROM QUASI-STELLAR AND OTHER RADIO SOURCES, by J. H. Fruin, J. V. Jelley and others. [1964] 2p. incl. table. (AFOSR-64-1761) (AF EOAR-63-80) AD 449061
Unclassified

Also published in Phys. Ltrs., v. 10: 176-177, June 1, 1964.

A system of two Cerenkov light detectors in fast coincidences to observe pulses of light from showers in the atmosphere was used. Preliminary measurements were made on clear moonless nights, to establish flux limits for γ-rays from the quasi-stellar sources 3C147, 3C196, 3C273, and have also observed the Crab Nebula and the magnetic variable at 53 Cam. Observations were carried out by comparing counting rates on the

source with regions 30° distant in azimuth, alternatively East and West, at the same zenith angle. Detection rates for showers varied with zenith angle but were about 100 showers/min at the zenith, with random rates set at about 2 counts/min. Observations were made between Jan. and Apr. 1964. (Contractor's abstract)

682

Duke U. [Dept. of Mathematics] Durham, N. C.

COMPLETELY MONOTONE SEQUENCES AS INVARIANT MEASURES, by R. Scoville. [1964] [12]p. (AFOSR-65-0320) (AF AFOSR-61-51) AD 611998
Unclassified

Also published in Trans. Amer. Math. Soc., v. 112: 318-329, Aug. 1964.

Let a = {a_n} be a completely monotone sequence of real numbers with $\Sigma_0^\infty a_n = 1$. Form a "building" consisting of length a_n, with a_{n+1} lying above a_n. Let T move points 1 level upward whenever possible, otherwise let T drop the point to the bottom level B_0 and apply a measure-preserving transformation S of B_0. To define S represent B_0 as a building corresponding to Δ_a, its base as a building corresponding to $\Delta^2 a$, and so on. The resulting transformation T_a, which preserves Lebesque measure, can also be represented as a transformation T acting continuously on the space of increasing sequences of non-negative integers. In the latter representation T is independent of a, but has an invariant measure μ_a determined by a. Any invariant probability measure for T is of the form μ_a for some a. T is ergodic relative to μ_a only if $a_n = \theta^n(1-\theta)$ for some $0 \leq \theta < 1$. Some results concerning the spectrum of T in this case are that when $\theta < \frac{1}{2}$, T has no prime roots of unity as eigenvalues, and all powers of T are ergodic. When restricted to the set U of unbounded sequences T is 1:1 and onto. By applying the Kryloff-Bogoliouboff decomposition theorem to the Borel system (T, U) it is possible to obtain the classical representation $a_n = \int_0^1 t^n d F_a(t)$, where F_a is an increasing function on [0, 1]. An inversion formula for F_a can also be obtained in this way. (Math. Rev. abstract)

683

Duke U. [Dept. of Mathematics] Durham, N. C.

RESEARCH IN PARTIAL DIFFERENTIAL EQUATIONS, by J. J. Gergen. Final technical rept. Jan. 4, 1963, 7p. (AF AFOSR-61-51) AD 295190   Unclassified

Papers and reports prepared under the project are listed. The list includes 14 papers published in mathematical journals, one published in a conference proceedings, and one available at the U. S. Department of Commerce, Office of Technical Services. Seven papers either submitted or accepted for publication are noted. (Contractor's abstract)

684

Duke U. Dept. of Mathematics, Durham, N. C.

OPEN IDEALS IN C(X), by L. A. Hinrichs. [1964] [9]p. (AFOSR-65-1004) (AF AFOSR-62-162) AD 618835   Unclassified

Also published in Pacific Jour. Math., v. 14: 1255-1263, 1964.

A group topology on the ring C(X), of all real-valued, continuous functions on X, is said to have the ideal closure property (L C. P.), in case the closure of any ideal is simply the intersection of all maximal ideal containing it. This paper considers which ideals of C(X) can be open with respect to such a topology. A characterization of such ideals is given and it is shown that the family $\mathcal{L}$, of all such ideals, is itself a fundamental system of neighborhoods of zero with respect to a ring topology having L C. P. The 2 extremes are considered where $\mathcal{L}$ is the family of all ideals and where $\mathcal{L}$ consists only of finite intersections of maximal ideals. Finally it is shown that if P is a countable discrete subset of the Stone-Cech compactification of X, then $\cap$ {M^p; $p \in P$} $\in \mathcal{L}$ if and only if P is C-embedded in $X \cup P$.

685

Duke U. [Dept. of Physics] Durham, N. C.

RADIATION CHEMISTRY IN THE SOLID STATE AS STUDIED WITH ELECTRON PARAMAGNETIC RESONANCE, by W. Gordy. Jan. 16, 1963, 19p. (AFOSR-J1297) (AF AFOSR-62-327) AD 424220
Unclassified

Presented at Internat'l. Conf. on Radiation Research, Army Natick Labs., Natick, Mass., Jan. 14-16, 1963.

This report contains: Characteristic ESR Patterns of Some Common Free Radicals; Nuclear Effects in the ESR of Hydrocarbon Free Radicals; Radiation Effects on Polypeptides; Oxygen Effect in Radiation Damage; and Chemical Protection from Ionizing Radiation.

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Duke U. [Dept. of Physics] Durham, N. C.

ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED SINGLE CRYSTALS OF SUGARS, by H. Ueda. [1963] [6]p. (AFOSR-64-0048) (AF AFOSR-62-327) AD 431087   Unclassified

Also published in Jour. Phys. Chem., v. 67: 2185-2190, 1963.

Single crystals of lactose hydrate, sucrose, methyl-d-glucoside, glucoronolactone, d-glucosamine-HCl, and diacetone sorbose were irradiated at 77°K and their e. s. r. spectra were observed immediately after irradiation or after annealing at 193°K. These sugars also were irradiated at room temperature, and their e. s. r. spectra were observed at this temperature. The

position of the substituted functional group in a substitute sugar molecule is more accessible to radiation damage than other positions in the molecule. Therefore, the positions are selectively damaged by irradiation. For this reason, the e. s. r. spectra of irradiated single crystals of sugar derivatives differ greatly from those found in the unsubstituted parent sugars. The free radicals formed in sugars by irradiation at 77°K are transformed by subsequent annealing. These transformation processes can be explained by a change in the configuration of the radical species in most instances. However, there are a few cases where the transformation includes migration of the free-radical site. (Contractor's abstract)

687

Duke U. [Dept. of Physics] Durham, N. C.

MILLIMETER WAVE SPECTROSCOPY OF UNSTABLE MOLECULAR SPECIES. 1. CARBON MONOSULFIDE, by R. Kewley, K. V. L. N. Sastry and others. [1963] [5]p. (AFOSR-64-1912) (AF AFOSR-62-327) AD 450510   Unclassified

Also published in Jour. Chem. Phys., v. 39: 2856-2860, Dec. 1, 1963.

The carbon monosulfide species CS^{32} and CS^{34} are investigated with a millimeter wave spectrometer designed for the study of short-lived molecules in the frequency range from 60,000 to 300,000 mc/sec. Spectroscopic constants were obtained. The spectrometer is described. Carbon monosulfide is not a free radical in that it has no resultant electronic moment. However, it is a very unstable molecular species and requires for its detection experimental methods similar to those employed for unstable free radicals. The present spectrometer was used in obtaining more complete information on its rotational constants. (Contractor's abstract)

688

Duke U. [Dept. of Physics] Durham, N. C.

APPLICATION OF ELECTRON SPIN RESONANCE TO THE DETERMINATION OF HYDROPEROXIDES, by H. Ueda. [1963] [2]p. (AFOSR-64-1962) (AF AFOSR-62-327) AD 452296   Unclassified

Also published in Anal. Chem., v. 35: 2213-2214, Dec. 1963.

There are few examples in which ESR has significant importance as an analytical technique. The experimental result, which is reported in this paper, will find an application to the determination of hydroperoxides in a solution. The solutions of 1,1-diphenyl-2-picryl hydrazyl (DPPH) in benzene, and in the case of tert-butyl hydroperoxide (BHPO) in several other solvents, were prepared. To these solutions, BHPO (containing 10% of tert-butyl alconol), cumene hydroperoxide (CHPO), peracetic acid (PAA) or meta-chloroperbenzoic acid (CPBA) was added and after a definite interval of time the ESR spectra were

observed. The ESR measurements were made on an X-band spectrometer at room temperature and the spectra were recorded as the second derivatives. The solvents used were reagent grade and were not treated to remove any dissolved oxygen. (Contractor's abstract)

689

Duke U. [Dept. of Physics] Durham, N. C.

FURTHER STUDIES OF RADIATION EFFECTS ON THE PROTEINS AND THEIR CONSTITUENTS, by R. A. Patten and W. Gordy. [1964] [16]p. (AFOSR-64-1963) (AF AFOSR-62-327) AD 452297   Unclassified

Also published in Radiation Research, v. 22: 29-44, May 1964.

The ESR patterns of γ-irradiated proteins have been obtained and compared with those of molecular and mechanical mixtures of their constituent amino acids. As in previous studies, the ESR patterns most often found are those characteristic of glycine and cystine (or cysteine) residues. Evidence is found, however, for free radicals formed from alanine and certain other residues in some of the proteins. Pronounced effects of atmospheric gases and of temperature changes are observed. The ESR patterns of the molecular mixtures of the amino acids are unlike either those of the mechanical mixtures or those of the proteins. (Contractor's abstract)

690

Duke U. [Dept. of Physics] Durham, N. C.

ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED SINGLE CRYSTALS OF METHACRYLAMIDE, by H. Ueda. [1964] [10]p. (AFOSR-64-1980) (AF AFOSR-62-327) AD 452403   Unclassified

Also published in Jour. Polymer Sci., v. 2: 2207-2216, 1964.

Irradiated single crystals of methacrylamide were studied by electron spin resonance. Irradiations were made at 77 and 288°K and measurements were made at 77, 193, and 293°K. Only chemical changes explain these spectra. The original scission is C-C breakage between $(CONH_2)$ and $CH_2 = C(CH_3)$-, and C-H breakage between $CH_2 = C-(CONH_2) CH_2$- and H; these small fragments react with methacrylamide and finally produce two free radicals at room temperature. These two free radicals are the ones which propagate or terminate the polymerization. (Contractor's abstract)

691

Duke U. [Dept. of Physics] Durham, N. C.

MICROWAVE AND MILLIMETER WAVE SPECTRA OF HYDRAZOIC ACID, by R. Kewley, K. V. L. N. Sastry, and M. Winnewisser. [1964] [15]p. (AFOSR-64-1981) (AF AFOSR-62-327) AD 452298 Unclassified

Also published in Jour. Molec. Spectros., v. 12: 387-401, Apr. 1964.

Five rotational transitions were recorded for each of the abundant species of hydrazoic acid and hydrazoic acid-d. Both molecules have normal centrifugal distortion behavior. The spectroscopic constants derived from the measurements are given. An important part of the study was a reinvestigation of the $J = 0-1$ transition of HN_3 which gave $eq_{aa}Q = +4.65 \pm 0.25$ mc/sec for the NH nitrogen N-14 nucleus. (Contractor's abstract)

692

Duke U. [Dept. of Physics] Durham, N. C.

MILLIMETER-WAVE MOLECULAR-BEAM SPEC-TROSCOPY: ALKALI CHLORIDES, by P. L. Clouser and W. Gordy. [1964] [8]p. (AFOSR-64-1920) (AF AFOSR-64-493) AD 450517   Unclassified

Also published in Phys. Rev., v. 134: A863-A870, May 18, 1964.

The pure rotational spectra of the alkali chlorides were investigated in the 0.96- to 3-mm range of the microwave region with the molecular-beam spectrometer earlier developed at Duke U. Introduction of Teflon microwave lenses and high-pass microwave filters improved this spectrometer so that measurements into the submillimeter region were possible, to an accuracy of better than one part in 1 million. Dunham's solution for the diatomic molecule was applied in interpretation of data. Improved values and derived quantities such as potential coefficients, isotopic mass ratios, moments of inertia, and internuclear distances are reported. For most of these quantities, the accuracies obtained surpass those from previous measurements. (Contractor's abstract)

693

Duke U. [Dept. of Physics] Durham, N. C.

EXTENSION OF SUBMILLIMETER WAVE SPECTROS-COPY BELOW A HALF-MILLIMETER WAVELENGTH, by G. Jones and W. Gordy. [1964] [2]p. (AFOSR-64-1921) (AF AFOSR-64-493) AD 450511
                              Unclassified

Also published in Phys. Rev., v. 135: A295-A296, July 20, 1964.

The earlier measurements in the region above one-half mm were made with harmonic generators driven by cm-wave klystrons. Attempts to extend the coverage below a half-mm with cm-wave fundamental energy failed. Recently, however, klystrons in the 5-mm range with output power of the order of 100 mW have become available. (Contractor's abstract)

694

Duke U. [Dept. of Physics] Durham, N. C.

CENTRIFUGAL DISTORTION EFFECTS AND STRUC-TURE OF HYDRAZOIC ACID FROM THE MILLIMETER WAVE ROTATIONAL SPECTRA, by M. Winnewisser and R. L. Cook. [1964] [6]p. (AFOSR-65-0110) (AF AFOSR-64-493) AD 455799   Unclassified

Presented at 1964 Spring meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

Also published in Jour. Chem. Phys., v. 41: 999-1004, Aug. 15, 1964.

Hydrazoic acid is a slightly asymmetric rotor with an abnormally large A_0 rotational constant. Recently, the rotational spectra of HN_3 and DN_3 have been reported from this laboratory. Subsequently, the rotational spectra of $^{15}HN^{14}N^{14}N$ and $^{14}HN^{14}N^{15}N$ have been investigated to yield an improved structure of hydrazoic acid and to study the influence of the c. m. position on centrifugal-stretching terms. Earlier work did not allow a reliable structure calculation since only the sum $(B_0 + C_0)$ was determined. However, the study of the millimeter wave spectra has enabled the determination of both A_0 and $(B_0 - C_0)$, and the evaluation of the internuclear distances. Values of the rotational constants are $^{14}N^{14}N^{15}NH$: $A_0 = 616916$ mc/sec, $B_0 = 11667.54$ mc/sec, $C_0 = 11427.86$ mc/sec; and $^{15}N^{14}N^{14}NH$: $A_0 = 616868$ mc/sec, $B_0 = 11641.76$ mc/sec, $C_0 = 11405.08$ mc/sec. The centrifugal-distortion effects of the high K_{-1} transitions can be accounted for only with the introduction of P^6 distortion constants.

695

Duke U. [Dept. of Physics] Durham, N. C.

ENERGY MIGRATION AND ISOTOPIC EFFECTS IN IRRADIATED SOLIDS AT LOW TEMPERATURE, by W. V. Bouldin and W. Gordy. [1964] [9]p. (AFOSR-65-0111) (AF AFOSR-64-493) AD 455922
                              Unclassified

Also published in Phys. Rev., v. 135: A806-A814, Aug. 3, 1964.

Energy migration to impurity molecules of hydrogen and methane trapped in solid matrices of argon and krypton at low temperature is shown to occur. The solid containing the impurity molecules in minute quantities was irradiated at 4.2°K with γ rays from CO^{60}, and the free radicals produced by dissociation of impurity molecules were measured from the intensity of their electron spin resonance signals. For concentrations of 0.001 mol fraction of CD_4 in A or Kr, over 500 times as many molecules of CD_4 were dissociated as would be expected from the same quantity of pure CD_4 given the same exposure dose. It is concluded that the dissociation of the dilute impurity is produced almost wholly by the energy absorbed by the matrix and transferred to the impurity molecules. In the

mixed isotopic species-HCD_3, H_2CD_2, and H_3CD it is shown from the relative strength of the ESR signals of H and D atoms that the C-H bond has about 5 times greater probability of being broken by the migrating energy than has a given C-D in the same molecule. This large isotopic effect is attributed to more rapid escape of H over D from the parent molecule within the lattice. (Contractor's abstract)

696

Duke U. Dept. of Physics, Durham, N. C.

SUBMILLIMETER-WAVE SPECTRA OF HCl AND HBr, by G. Jones and W. Gordy. [1964] [4]p. incl. illus. diagr. tables, refs. (AFOSR-65-0410) (AF AFOSR-64-493) AD 612322   Unclassified

Also published in Phys. Rev., v. 136: A1229-A1232, Nov. 30, 1964.

The $J = 0 \rightarrow 1$ transitions of HCl and HBr have been measured in the wavelength regions of 0.59 and 0.48 mm, respectively. These measurements led to the following values of molecular constants: for HCl^{35}, $v_0 = 625\ 919.24 \pm 0.52$ mc/sec, $eQq = 63.0 \pm 2.8$ mc/sec, $C_I \approx 0$, $B_0 = 312\ 991.30 \pm 0.26$ mc/sec, $B_e = 317\ 587$ mc/sec, $r_0 = 1.2838_7$ A, $r_e = 1.2745_5$ A; for HBr^{79}, $v_0 = 500\ 675.24 \pm 0.52$ mc/sec, $eQq = 535.4 \pm 1.4$ mc/sec, $C_I = 0.29 \pm 0.20$ mc/sec, $B_0 = 250\ 360.78 \pm 0.13$ mc/sec, $B_e = 253\ 790$ mc/sec, $r_0 = 1.4243_9$ A, $r_e = 1.4146_0$ A; and for HBr^{81}, $v_0 = 500\ 519.41 \pm 0.26$ mc/sec, $eQq = 447.9 \pm 1.4$ mc/sec, $C_I -0.31 \pm 0.20$ mc/sec, $B_0 = 250\ 282.88 \pm 0.13$ mc/sec, $B_e = 253\ 710$ mc/sec, $r_0 = 1.4140_2$ A, $r_e = 1.4146_0$A.

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Duke U. Dept. of Physics, Durham, N. C.

MILLIMETER WAVE SPECTROSCOPY OF UNSTABLE MOLECULAR SPECIES. II. SULFUR MONOXIDE, by M. Winnewisser, K. V. L. N. Sastry and others. [1964] [5]p. incl. illus. diagrs. tables, refs. (AFOSR 65-0411) (AF AFOSR-64-493) AD 612323
Unclassified

Also published in Jour. Chem. Phys., v. 41: 1687-1691, Sept. 15, 1964.

Several spectral transitions of the gaseous free radical SO have been observed in the millimeter wave region. Analysis of the observed lines confirms that the molecule has a $^3\Sigma$ ground state and leads to the rotational constants $B_0 = 21\ 523.75$ mc/sec and $D_0 = 0.0334$ mc/sec, also to the magnetic coupling constants $\lambda = 158\ 209.4$ mc/sec and $\gamma = -164.52$ mc/sec. The assignments and analysis are confirmed by a close fitting, within approximately 1 mc/sec, of all measured

and calculated frequencies, and by the Zeeman effect which is measured and analyzed for several transitions. (Contractor's abstract)

698

Duke U. Dept. of Physics, Durham, N. C.

ELECTRON PARAMAGNETIC RESONANCE OF VANADYL IONS TRAPPED IN RNA AND DNA, by W. Snipes and W. Gordy. [1964] [2]p. incl. diagr. (AFOSR-65-1120) (AF AFOSR-64-493) AD 620482
Unclassified

Also published in Jour. Chem. Phys., v. 41: 3661-3662, Dec. 1, 1964.

Electron resonances in RNA and DNA with a variety of intensities and line shapes have been found, most of which have been attributed to the transition elements in the nucleic acid samples. In the present investigation, a well-resolved spectrum of 8 components was found in 3 commercially obtained samples of RNA. The octet appears to be a hyperfine structure arising from the ^{51}V nucleus, for which I, the nuclear spin quantum number, = 7/2. The electron paramagnetic resonance spectrum is that of the vanadyl ion VO^{2+} trapped in some manner in the RNA molecule. Whether these vanadyl ions have a biological origin and function is not known.

699

Duke U. [Dept. of Physics] Durham, N. C.

MILLIMETER WAVE SPECTRUM OF SULFUR MONOXIDE (Abstract), by M. Winnewisser, K. V. L. N. Sastry, and W. Gordy. [1964] [1]p. (AF AFOSR-64-493)   Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

With a new type of millimeter wave spectrometer for the study of short-lived molecules, we have detected 4 rotational transitions in SO, a short-lived gaseous free radical in a $^3\Sigma$ electronic ground state. The observed frequencies are 99 299.85, 127 177.44, 138 178.60, and 172 181.46 mc/sec. An assignment of the frequencies to a particular transition is still somewhat uncertain, but it is hoped that a definite assignment and analysis will be possible soon. With a magnetic field of only 4 G, all lines show a Zeeman triplet. With an electric-field strength of 1500 v/cm, we could not detect any Stark splitting. Earlier efforts to detect the microwave spectrum of SO failed but led to detection of lines attributed to S_2O and SO_2.

700

Duke U. [Dept. of Physics] Durham, N. C.

NUCLEAR ^{33}S HYPERFINE STRUCTURE IN THE ESR

OF γ-IRRADIATED CYSTINE DI-HYDROCHLORIDE, by J. Hadley and W. Gordy. [1964] [1]p. (AF AFOSR-64-493)   Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

Hyperfine components of ^{33}S nuclear magnetic coupling have been detected in the electron spin resonance of free radicals produced by irradiation of single crystals of cystine di-hydrochloride. The ^{33}S in the sample was in its natural abundance of 0.74%. Preliminary analysis of the data indicates that the principal radical formed in the crystal at room temperature is the disulfide radical RSS, although the g tensor indicates that the monosulfide radical RS of the form postulated by Kurita and Gordy is also present.

701

Duke U. [Medical Center] Durham, N. C.

COGNITIVE STRUCTURING, FIELD DEPENDENCE-INDEPENDENCE AND THE PSYCHO-PHYSIOLOGICAL RESPONSE TO PERCEPTUAL ISOLATION, by C. M. Culver, S. I. Cohen and others. June 1963, 10p. (AFOSR-64-1304) (AF AFOSR-63-57) AD 444259   Unclassified

Also published in Proc. Soc. Biol. Psychiat; Eighteenth Annual Conv. and Scientific Program, Atlantic City, N. J. (June 7-9, 1963), 1963, p. 119-126.

This study investigated the effects of an individual difference variable (the body-field dimension) and an experimentally manipulated situational variable (amount of prior information given to subjects) on the psychophysiological response to a 2-hr perceptual isolation experience. Both body and field subjects showed more GSR nonspecifics when undergoing the low-information experimental condition than the high-information control condition. However, the experimental and control conditions had a differential effect on the groups' heart rate levels: field-experimental and body-control subjects showed a higher heart rate than did their field-control and body-experimental counter-parts. These physiological differences, which only approached significance, were discussed in terms of possible different patterns of physiological arousal in the two groups. (Contractor's abstract)

702

Duke U. Medical Center, Durham, N. C.

PHYSIOLOGIC DISCRIMINATION AND BEHAVIORAL RELATIONSHIPS IN HUMAN INSTRUMENTAL CONDITIONING, by L. A. Graham, S. I. Cohen, and B. M. Shmavonian. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-64-1957) (AF AFOSR-63-57) AD 450319   Unclassified

Presented at annual meeting of the Soc. of Psychophysiological Research, Detroit, Mich., Oct. 13, 1963.

Also published in Psychosomatic Med , v. 26: 321-336, July-Aug. 1964.

Thirty-three human subjects were exposed to a discrimination instrumental-conditioning design in which the response was a punch-avoidance. The patterns of behavior associated with vague instructions were observed, as were the GSR and heart-rate changes accompanying the different behavioral responses. It was found that GSR discrimination occurred prior to avoidance learning, whereas heart-rate discrimination occurred only with avoidance itself. Some implications of the relationships between the physiologic changes and acquired motor behavior are discussed with regard to the production of hypertensive cardiovascular disease. (Contractor's abstract)

703

Duke U. [Medical Center] Durham, N. C.

BODY AND FIELD PERCEPTUAL DIMENSION AND ALTERED SENSORY ENVIRONMENTS, by S. I. Cohen and A. J. Silverman. Annual rept. Oct. 1962 - Oct. 1963. Oct. 1964, 35p. (AF AFOSR-63-57) AD 427213   Unclassified

A total of 406 subjects have been tested for perceptual mode and used in a series of experiments over the past 3 yrs. One hundred ar five subjects were body-oriented: 212 fell into a middle range and 75 have been field-oriented. In the experiments now being conducted many subjects are being studied in a number of experimental sessions so that the scope of the individual samples will be considerably broadened. The investigations described in this report and previous reports have been undertaken to delineate more carefully differences in body-oriented and field-oriented subjects. Differences in autonomic and behavioral conditioning characteristics together with differences in discrimination learning have been studied. One of the results of this series of experiments may be to lead to the development of techniques to influence the efficiency with which goal directed behavior is maintained or to influence the rapidity of learning complex perceptual and motor tasks (e. g., tasks which are carried out in response to certain signals).

704

Duke U. Medical Center, Durham, N. C.

PERCEPTUAL MODE AND PAVLOVIAN TYPOLOGY, by P. Hein, S. I. Cohen, and B. M. Shmavonian. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-1364) (AF AFOSR-64-57) AD 616825   Unclassified

Also published in Recent Advances in Biol. Psychiat.; Proc. Nineteenth annual Conv. and Scientific Program, Soc. Biol. Psychiat., Los Angeles, Calif., (May 1-3, 1964), ed. by J. Wortis. New York, Plenum Press, v. 7: 71-76, 1964.

Eleven field-dependent and 11 field-independent subjects were compared in an autonomic conditioning design using one reinforced and 4 nonreinforced colored lights.

The galvanic skin response data indicate that the field-independent group demonstrate more responsiveness and "activation" well as greater differentiation in their specific responses to the reinforced when compared to the einforced lights.

705

Dynamic Science Corp., South Pasadena, Calif.

SEVENTEENTH AFOSR CONTRACTORS' MEETING ON LIQUID PROPELLANT ROCKET AND AIR-BREATHING COMBUSTION RESEARCH; ABSTRACTS OF PAPERS, Pasadena, Calif., July 6-8, 1964 [32]p. (AFOSR-64-0258) (AF 49(638)1151) AD 623846
Unclassified

Abstracts from papers given at the meeting are presented. Combustion instability and supersonic combustion are given special consideration. Detonative combustion, liquid jets, hot gas temperature profiles, and other aspects of liquid rocket motors are also considered.

706

Dynatech Corp., Cambridge, Mass.

TOROIDAL MEMBRANE UNDER INTERNAL

PRESSURE, by J. L. Sanders, Jr. and A. A. Liepins. [1963] [6]p. incl. diagrs. table. (AFOSR-64-0918) (AF 49(638)1096) AD 407750   Unclassified

Presented at AIAA Launch and Space Vehicle Shell Structure Conf., Palm Springs, Calif., Apr. 1-3, 1963.

Also published in AIAA Jour., v. 1: 2105-2110, Sept. 1963.

In the case of a circular toroidal membrane under internal pressure there is no solution of the linear membrane equations for which the displacements are continuous. One possible resolution of the difficulty depends on introduction of an internal bending boundary layer. Another possibility more appropriate for very thin shells is to resort to the nonlinear membrane theory. The present paper is concerned with another method of solving the nonlinear membrane equations of this problem. The equations are reduced to a linear second order differential equation for the rotation of shell elements in which the coefficient of the undifferentiated term contains a large parameter. The equation is amenable to asymptotic methods of integration and the solution is obtained in terms of two analytic functions of a single variable. These two functions together with their first derivatives and certain integrals pertinent to the problem are tabulated in this paper. With the help of these tables the title problem can be solved for practical ranges of the parameters without resort to further machine calculations.

707

Edinburgh U. [Dept. of Physiology] (Gt. Brit.).

SMOOTH MUSCLE RESPONSES AS ALTERED BY
HUMORAL BACKGROUND, by L. M. Pickford. Final
rept. Dec. 31, 1964 [22]p. incl. diagrs. refs.
(AFOSR-65-0664) (AF EOAR-62-79) AD 614478
Unclassified

In man, monkey, rat and dog oxytocin normally has a
vasodilator effect. Following surgical or chemical
sympathetic denervation oxytocin becomes a vasocon-
strictor. The dilator effect can be restored by infusing
adrenaline or stimulating the sympathetic nerves.
Oxytocin also becomes a vasoconstrictor when the cir-
culating concentration of estrogens is raised either
naturally in the presence of estrogens (as in rats in es-
trus) or experimentally. In dogs the dilator response
to oxytocin can be restored by giving atropine, and
then either infusing adrenaline or stimulating the sym-
pathetic nervous system. (Contractor's abstract)

708

Electro-Optical Systems, Inc., Pasadena, Calif.

INVESTIGATION OF THE PHENOMENA IN CROSSED-
FIELD PLASMA ACCELERATORS, by M. R. Denison
and R. W. Ziemer. 1963, 48p. (AFOSR-5185)
(AF 49(638)1063) AD 414092　Unclassified

Presented at AIAA Fifth Biennial Gas Dynamics Sym-
posium, Physico-Chemical Diagnostics of Plasmas,
Evanston, Ill., Aug. 14-16, 1963.

The acceleration of a plasma by means of a crossed
field accelerator is beset by problems which as yet do
not have adequate explanations. The experimentally
observed effects include: the sudden drop in thrust
with increasing magnetic field strength, extremely
unsymmetrical electrode heating, and lack of accel-
eration in some closed channel accelerators. These
problems also have their counterparts in MHD gen-
erators. In order to obtain a better understanding of
the physical phenomena associated with J x B accel-
eration, an analytical and experimental diagnostic
study was undertaken. A primary objective is to de-
termine and understand the current density distribu-
tion in the discharge region. (Contractor's abstract)

709

Electro-Optical Systems, Inc., Pasadena, Calif.

PLASMA DIAGNOSTICS STUDIES FOR CROSSED
FIELD ACCELERATORS, by A. Proudian. Mar. 1963,
30p. (AFOSR-5074) (AF 49(638)1063) AD 415622
Unclassified

Diagnostic methods investigated include: Spectroscopic
and Interferometric Methods -- Optical Interferometry,
Continuum Intensity, Line Shape (Series Limit), and
Relative and Absolute Line Intensity Measurements;
Measurements Involving the Use of Particle Beams --
Electron scattering, Charge Exchange, and Excitation
of Target Gas. (Contractor's abstract)

710

Erlangen U. (Germany).

[MAXIMAL HOLOMORPHIC AND MEROMORPHIC
REPRESENTATION, II] Maximale holomorphe und
meromorphe abbildungen, II, by K. Stein. [1964] 49p.
incl. refs. (AFOSR-65-2972) (AF EOAR-62-40)
AD 627547　Unclassified

Also published in Amer. Jour. Math., v. 86: 823-868,
Oct. 1964.

Theorem I: Let f: X → Y be a holomorphic map of the
irreducible complex space X into the complex space Y.
Suppose that an analytic subset A ≠ φ of X exists such
that f|A:A → Y is proper, and such that r(f|A) = f(f).
Then a complex base (f*, Y*) of f exists. It has dim
Y* = r(f). If X is normal, so is Y*. If X and Y are
normal, the ring of holomorphic functions on X which
strictly depend on f is isomorphic to a ring which is
entire and finite over the ring of holomorphic func-
tions on Y. Other properties of maximal holomorphic
maps are studied. For instance, a maximal holo-
morphic map induces an epimorphism on the funda-
mental groups if the spaces are irreducible.

711

Flight Sciences Lab., Inc., Buffalo, N. Y.

A PARAMETRIC STUDY AND SURVEY OF THE
THEORETICAL PERFORMANCE OF THE SUBSONIC
COMBUSTION RAMJET, by B. Omilian. Oct. 1963,
84p. (AFOSR-5351) (AF 49(636)1173) AD 433723
Unclassified

The performance of the subsonic combustion ramjet
over the range from mach 3 to 8 is presented, showing
the effects of systematic variations in component ef-
ficiencies and flight conditions. Fuels considered are
hydrogen, ethylene, and pentaborane. Performance
predictions in the literature are reviewed and com-
pared, and differences discussed. The present results
are included in the comparison. (Contractor's abstract)

712

Florence U. (Italy).

[STUDIES ON THE ASTRONOMICAL ORIENTATION OF
LITTORAL AMPHIPODS IN THE EQUATORIAL ZONE.
IV. DAILY DIFFERENTIAL COMPENSATION FOR
THE AZIMUTHAL MOTION OF THE SUN IN A SOMA-
LILAND POPULATION OF TALORCHESTIA MARTEN-
SII WEBER] Recerche sull'orientamento astronomico
di anfipodi litorali della zona equatoriale. IV. Com-
pensazione differenziale giornaliera del moto azimu-
tale dei sole in una popolazione somala di Talorchestia
Martensii Weber, by A. Ercolini. [1964] 11p. incl.
diagrs. refs. (AFOSR-66-1109) (AF EOAR-64-55)
AD 639537   Unclassified

Also published in REDIA, v. 49: 119-126, 1964.

A shifting experiment has been carried out by keeping
the animals under a rhythm of artificial light-darkness
3 hr in advance in respect to the normal one. The re-
sults obtained in 19 tests of solar orientation (from the
7th to the 10th day from the beginning of the treatment)
show that the capacity of differential compensation of
the solar azimuth velocity is essentially regulated by
internal information. Some ambiguities of behavior
observed during the tests do not permit, however, the
exclusion of the influence of external information on
the orientated behavior of the animals, at least during
a transitory period in the process of phase-displace-
ment.

713

Florida State U. Dept. of Chemistry, Tallahassee.

SYNTHESIS OF PEPTIDE POLYMERS WITH RE-
PEATING SEQUENCES, by D. F. DeTar, W.
Honsberg and others. [1963] 2p. (AFOSR-65-1250)
(AF AFOSR-62-279) AD 621665   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 65:
2873-2874, 1963.

A general route was developed to an important class
of peptide polymers having known repeating sequences

in chains of random length. The active ester method
was found to be the most suitable for preparing L-Asp-
(OCH_3)-Gly-Gly)$_n$ with average degrees of polymeriza-
tion estimated to be 25 or more. The polymerization
is monitored by the NMR spectra in trifluoroacetic
acid solutions. Comparable results were obtained with
$(Asp-(OCH_3)$-Phe-Gly)$_n$ and (His-Gly-Gly)$_n$ from the
corresponding tripeptide derivatives and (Phe-Gly)$_n$
from HBr · H · -Phe-Gly-ONP.

714

Florida State U. [Dept. of Physics] Tallahassee.

THE Al^{27} $(p, \alpha)Mg^{24}$ REACTION WITH 3 TO 12 MEV
PROTONS, by K. L. Warsh, G. M. Temmer, and
H. R. Blieden. Feb. 11, 1963, 9p. (AFOSR-J960)
(AF AFOSR-62-423) AD 416061   Unclassified

Also published in Nucl. Phys., v. 44: 329-337, 1963.

Excitation curves and angular distributions of α-parti-
cle groups from the reaction $Al^{27}(p, \alpha)Mg^{24}$ have been
determined between 3 and 12 mev proton energy. The
behavior of the excitation curves signifies that the re-
action proceeds through the compound nucleus process.
The large asymmetries in the angular distributions
about 90° in the center-of-mass system might lead one
to believe that there are important contributions from
direct reaction processes; however, the shapes of the
angular distributions vary quite rapidly with energy,
much more rapidly than should be the case for direct
reactions. Also, large asymmetries are observed in
the angular distributions to highly excited states. A
direct reaction leading to these states would have to
proceed by a very complicated process, which would
make such an assumption improbable. The resonances
seen in the excitation curves are too widely separated
to correspond to individual levels at these excitation
energies (15-23 mev) and must be regarded as fluc-
tuation in level density. (Contractor's abstract, modi-
fied)

715

Florida State U. [Dept. of Physics] Tallahassee.

THE REACTION Na^{23} $(p, \alpha)Ne^{20}$ FROM 3 TO 12 MEV.
by K. L. Warsh, G. M. Temmer, and H. R. Blieden.
[1963] 6p. (AFOSR-64-0519) (AF AFOSR-63-440)
AD 436160   Unclassified

Also published in Nucl. Phys., v. 46: 45-50, 1963.

The excitation curves were measured for the ground-
state and first-excited state α-particle groups from the
reaction $Na^{23}(p, \alpha)Ne^{20}$ between 3 and 12 mev proton
energy, as well as angular distributions for the ground-
state and first three excited-state α transitions, at
10.0 mev bombarding energy. Excited states of
Ne^{20} up to the tenth were observed, including two new
ones at 5.60 and 7.02 mev. (Contractor's abstract)

716

Florida State U. [Dept. of Physics] Tallahassee.

LOW-ENERGY CHARGED-PARTICLE-INDUCED FIS-
SION, by G. R. Choppin, J. R. Meriwether, and J. D.
Fox. [1963] 4p. (AFOSR-64-0535) (AF AFOSR-63-
440) AD 436159   Unclassified

Also published in Phys. Rev., v. 131: 2149-2152,
Sept. 1, 1963.

The excitation functions for the proton and deuteron in-
duced fission of Th^{232} and U^{238} have been determined
in the energy range of 3-12 mev. The excitation func-
tions were measured using direct counting with p,n
junction counters, gross counting with a recoil catch-
ing technique, and radiochemical measurement of
certain fission product nuclides. In addition, the ratio
of the peak-to-valley values of the fission fragment
kinetic-energy spectrum were determined as a function
of bombarding energy. Breaks in the ratio curve at
certain bombarding energies are interpreted in terms
of competition between fission and nucleon evaporation.
(Contractor's abstract)

717

Florida State U. [Dept. of Physics] Tallahassee.

ELASTIC SCATTERING OF α PARTICLES BY C^{12} IN
THE BOMBARDING ENERGY RANGE 10 TO 10 MEV,
by E. B. Carter, G. E. Mitchell, and R. H. Davis.
Oct. 7, 1963, 13p. (AFOSR-64-1146) (AF AFOSR-63-
440) AD 442824   Unclassified

Also published in Phys. Rev., v. 133: B1421-B1433,
Mar. 23, 1964.

The scattering of α particles by C^{12} has been studied
in the bombarding energy range 10 to 19 mev. Many
anomalies were observed in the excitation curves which
correspond to O^{16} compound system energy levels in
the excitation energy range 14 to 21 mev. Fifteen de-
tailed angular distributions were measured and the data
have been analyzed with a smooth cutoff model which
was modified to include appropriate resonant phase
shifts. The spins and parities of the more prominent
resonances have been assigned. Real well depths of
100 mev or more were required in an optical-model
analysis to yield theoretical cross sections compara-
ble with experimental values. In general, optical-
model fits were not satisfactory. Two series of levels
in O^{16} were observed which obey rotational band sys-
tematics. The substantial widths of the band members
suggest an α-particle cluster configuration for these
excited states. (Contractor's abstract)

718

Florida State U. [Dept. of Physics] Tallahassee.

INELASTIC SCATTERING OF 6- TO 19-MEV α PAR-
TICLES FROM CARBON, by G. E. Mitchell, E. B.
Carter, and R. H. Davis. [1964] 12p. (AFOSR-64-
1147) (AF AFOSR-63-440) AD 442823   Unclassified

Also published in Phys. Rev., v. 133: B1434-B1445,
Mar. 23, 1964.

The inelastic scattering of α particles from C^{12} was
studied in detail. The 4.43-mev γ rays were observed
from 6- to 17-mev bombarding energy; the particles
were observed from 10 to 19 mev. Analysis of the γ-
ray data yielded the following specific conclusions: (1)
Near 13.1-mev excitation energy in O^{16} there is ap-
parently a 2^+ level in addition to the well known 1^-
level. (2) The 13.27-mev level is 3^-, as previously re-
ported. (3) The previously unassigned state at 13.88
mev is 4^+. (4) A previously unreported level at 14.80
mev has a low spin value. Numerous additional levels
were found. The "two-channel" coupled equations ap-
proximation predicts many of the qualitative features
of the particle angular distributions. Since the coupling
is very strong, calculations for C^{12} illustrate well some
of the features of this approximation. (Contractor's
abstract)

719

Florida State U. [Inst. of Molecular Biophysics]
Tallahassee.

RESEARCH IN PHOTOBIOLOGY AND PHOTOCHEM-
ISTRY, by H. Gaffron. Final rept. Apr. 1, 1963 - Apr.
30, 1964. June 23, 1964, 6p. (AFOSR-64-1192)
(AF AFOSR-62-190) AD 602756   Unclassified

Work in the following areas is briefly summarized:
stepwise photooxidation of ascorbate by illuminated
flavin in homogenous solution; reversibility of herbi-
cide action; use of isolated chloroplasts as light-ab-
sorbing constituents in artificial photooxidations; light-
induced acetate assimilation in algae; simultaneous
release of H_2 and O_2 from adapted algae in light when
CO_2 is absent.

720

Florida State U. [Inst. of Molecular Biophysics]
Tallahassee.

FLAVIN SPECIFIC AND MANGANESE DEPENDENT
ACTION OF CERTAIN HERBICIDES ON PHOTOREAC-
TIONS IN VITRO, by P. Homann. [1964] [1]p.
(AFOSR-65-1285) (AF AFOSR-62-190)
                                  Unclassified

Also published in Plant Physiol., Suppl., v. 39: 33,
1964.

Substituted ureas are very efficient herbicides due to
their ability to stop oxygen evolution in photosynthesis.
Nothing is known about the mechanism. These herbi-
cides strongly influence some dye-sensitized light re-
actions in vitro, provided the sensitizing dyes are
flavins. It was found that the herbicides CMU (N-p-
chlorophenyl-N', N'-dimethyl urea) and DCMU (N-p-
dichlorophenyl-N', N'-dimethyl urea) form charge
transfer complexes with excited flavin. Hydrophilic
molecules, i.e., tryptophane or tyrosine, are able

to do the same but they exhibit no specificity as to the
type of sensitizer. They inhibit equally well the anaer-
obic photoreduction of phthaleins, acridines and
thiazines. CMU and DCMU by contrast show no effect
whatever with acridine or thiazine photo-reduction and
only a negligible inhibition with the phthalein dye.
Among all substances tested as inhibitors of the bleach-
ing of dyes, only the substituted ureas are so highly
lipophilic that they accumulate in the lipid phase of
the chloroplast. Inasmuch as DCMU is more lipophilic
than CMU, it is the more effective herbicide. Certain
effects of the substituted ureas in vitro become mani-
fest only in the presence of manganese, a striking
parallelism to events taking place in the living chloro-
plast.

721

Florida State U. [Inst. of Molecular Biophysics]
Tallahassee.

PHOTOCHEMISTRY AND METAL CATALYSIS: STUD-
IES ON A FLAVIN SENSITIZED OXIDATION OF AS-
CORBATE, by P. Homann and H. Gaffron. [1964]
[21]p. incl. diagrs. tables, refs. (AFOSR-65-1286)
(AF AFOSR-62-190) AD 621285   Unclassified

Presented at Symposium on Molecular Mechanisms in
Photobiology, Wakulla Springs, Fla., Feb. 16-21,
1964.

Also published in Photochem. and Photobiol., v. 3:
499-519, 1964.

The interaction between ascorbate, diketogulonate,
manganous ion, oxygen, illuminated flavins, and
phenylureas was investigated. These photochemical
reactions in aqueous solutions exhibit peculiar reac-
tion kinetics, which resemble certain processes of
photosynthesis in living plants. The reaction mecha-
nisms are proposed. It is concluded that organic com-
pounds such as 3-(p-chlorophenyl)-1, 1-dimethylurea
form stable charge transfer complexes with excited
flavin molecules.

722

Florida U., Gainesville.

UPPER BOUNDS FOR PERMANENTS OF (0,1)-
MATRICES, by H. Minc. [1963] 3p. (AFOSR-64-
0711) (AF AFOSR-62-168) AD 436493
                                        Unclassified

Also published in Bull. Amer. Math. Soc., v. 69:
789-791, Nov. 1963.

Bounds for permanents of general (0,1)-matrices and
for permanents of certain subclasses of (0,1)-matrices
are of combinatorial significance and yet virtually the
only known upper bound for the permanent is the prod-
uct of row sums of A. A significant upper bound is
given for the permanent of a general (0,1)-matrix.

723

Florida U. Dept. of Psychology, Gainesville.

SLEEP PATTERNS IN YOUNG ADULTS: AN EEG
STUDY, by R. L. Williams, H. W. Agnew, Jr., and
W. B. Webb. [1964] 6p. incl. diagr. tables. (AFOSR-
65-2681) (AF AFOSR-62-13) AD 628254
                                        Unclassified

Also published in Electroencephalog. and Clin. Neuro-
physiol. Jour., v. 17: 376-381, 1964.

EEG sleep stages do not appear in any consistent tem-
poral sequence from night to night in a given subject
nor in a group of subjects. The typical young adult in
our study spent an individually characteristic relative
amount of time in each sleep stage each night. The
length of stages was short, usually less than 10 min,
with the exception of stage 1-REM which ranged up to
39 min in length. Our subjects characteristically
changed stages fewer times on successive nights. The
number of sleep stage changes differed among subjects.
The stage change was usually smooth, moving from one
stage to the next when sleep was deepening, but less
smooth, often 'jumping' more than a stage during arousal
from deeper levels. The EEG sleep stages were found
to be most prevalent in certain thirds of the night. The
greatest amounts of stages 4 and 3 were found in the
first third, 1-REM in the last third of the night. Stage
2 is more evenly distributed throughout the night.
(Contractor's abstract)

724

Florida U. Dept. of Psychology, Gainesville.

THE EFFECTS OF STAGE FOUR SLEEP DEPRIVA-
TION, by H. W. Agnew, Jr., W. B. Webb, and R. L.
Williams. [1964] 3p. incl. table. (AFOSR-65-2682)
(AF AFOSR-62-13) AD 629171   Unclassified

Also published in Electroencephalog. and Clin Neuro-
physiol. Jour., v. 17: 68-70, 1964.

Individuals may be deprived of stage 4 sleep without a
deprivation of the quantitative amount of sleep, i.e.
they may be 'moved' from stage 4 sleep into other
stages of sleep without awakening. The 'movement' of
sleep, in this experiment, did not occur consistently
into any other stage. Such deprivation of stage 4 sleep
results in a significant increase in this type of sleep
during a recovery night. These results, particularly
the latter, would suggest a requirement for this type
of sleep. When comparing our results with the Dement
study, we might also describe our findings as suggest-
ive of a psychic need, or propose that 'stage 4 depriva-
tion' results in a requirement for sleep associated
with this type EEG activity. The latter interpretation
is preferred. (Contractor's abstract)

725

Florida U. Engineering and Industrial Experiment
Station, Gainesville.

RESPONSE OF ELASTIC STRUCTURE TO RANDOM
EXCITATIONS OF VARIOUS CORRELATIONS, by
M. R. P. Trubert. Aug. 1963, 60p. incl. illus. diagrs.
(AFOSR-5319) (AF AFOSR-62-313) AD 416302;
AD 419341   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35:
1009-1022, July 1963. (Title varies)

It is shown that it is possible to determine the response
of a linear continuous structure (cantilever beam) to
random loadings of various correlations by a semiex-
perimental method. The mathematical aspect of the
problem is stated. The spatial transfer function rep-
resenting the dynamic characteristics of the struc-
ture is determined experimentally by a cross-correla-
tion technique. The response to various correlated
loadings is computed and a comparison is made with
the response determined experimentally. The effect
of the correlation is noted. (Contractor's abstract)

726

Florida U. Engineering and Industrial Experiment
Station, Gainesville.

RESPONSE OF A NONLINEAR BEAM TO RANDOM
EXCITATION, by R. E. Herbert. May 1964, 22p.
incl. diagrs. refs. (AFOSR-64-0386) (AF AFOSR-
62-313) AD 444475   Unclassified

For abstract see item no. 727, Vol. 7.

727

Florida U. Engineering and Industrial Experiment
Station, Gainesville.

RANDOM VIBRATIONS OF NONLINEAR ELASTIC
STRUCTURES, by R. E. Herbert. May 1964, 37p.
(AFOSR-64-0887) (AF AFOSR-62-313) AD 602486
                                             Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36:
2090-2094, Nov. 1964. (AFOSR-65-1233; AD 622639)

The theory of the Markoff process and the associated
Fokker-Planck equation is used to investigate the
large vibrations of a hinged, axially restrained, elastic
beam driven by white noise. An expression for the
joint probability-density function of the first N modal
amplitudes is obtained and used to derive an approxi-
mate expression for the mean-squared displacement.
Numerical integration of the exact expression for the
mean-squared displacement indicates a reduction of
this quantity as compared to the linear theory. Cal-
culations also show a range of applicability of the de-
rived approximate expression. Furthermore, compu-
tations show that the first node still gives a good esti-
mate of the mean-squared displacement, but the
coupling effects of the nodes are so strong, for

sufficiently large deflections, that the effect of the
higher modes must be taken into account when comput-
ing the mean-squared value of the first mode.

726

Florida U. Engineering and Industrial Experiment
Station, Gainesville.

ON THE STRESSES IN A NONLINEAR BEAM SUBJECT
TO RANDOM EXCITATION, by R. E. Herbert. Aug.
1964, 23p. incl. diagrs. refs. (AFOSR-64-1038)
(AF AFOSR-62-313) AD 606810   Unclassified

The method of equivalent linearization is used to inves-
tigate the effects of the membrane force on the
stresses in a simply supported Bernoulli-Euler beam
subject to random excitation. It is shown that, while
the mean-square membrane stress is negligible com-
pared to the mean-square bending stress, the former
nevertheless has the effect of reducing the latter.
Furthermore, this reduction is less significant for
higher driving frequencies, thereby reducing any 'non-
linear safety factor' that might be considered. (Con-
tractor's abstract)

729

Fordham U. Dept. of Chemistry, New York.

SMALL RING COMPOUNDS, by E. J. Moriconi. Final
rept. Oct. 1, 1961 - Sept. 30, 1963. Nov. 15, 1963, 6p.
(AFOSR-J1369) (AF AFOSR-62-18) AD 426566
                                             Unclassified

This report contains progress reports on the following
topics: (1) Ring expansion reaction; (2) Heteropolar
Ozonization of Aza-aromatics and their N-oxides; (3)
Origin of the carbonyl doublet in 2-indanone and trans-
Hexahydro-2-indanone; (4) NMR studies of N-hydroxy-
2-pyridone ⇌ 2-hydroxypyridine-1-oxide equilibria;
(5) Synthesis of fused aza-aromatic cyclobutadiene
derivatives; quinoxalino-[2,3-c] cyclobutadiene; (6)
Synthesis of strained azabicyclooctanes; 7- and 2-
azabicyclo [4.2] octanes; (7) Fused-ring aromatic
azetes. 3-diazooxindoles and 2-diazoindoxyls; and (8)
Valence tautomerism of the aza-cyclooctatriene ring
system.

730

Fordham U. [Dept. of Chemistry] New York.

HETEROPOLAR OZONIZATION OF AZA-AROMATICS
AND THEIR N-OXIDES, by E. J. Moriconi and F. A.
Spano. [1964] 9p. incl. tables, refs. (AFOSR-64-
0664) (AF AFOSR-62-16) AD 436500   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 38-
46, 1964.

The ozonization of four aza-aromatics [1-methyl-(II)
and 3-methylisoquinoline (II), acridine (III), and
phenanthridine (IV) and five aza-aromatic N-oxides
[quinoline-1-(V), phenanthridine-5-(VI), acridine-10-

(VII), isoquinoline-2-(VIII), and 3-methylisoquinoline-2-oxides (IX)] are reported. Initial electrophilic ozone attack on III, IV, I, and II led to carbocyclic ring-cleaved carboxylic acids; simultaneous nucleophilic ozone attack at the C-atom adjacent to (4), or conjugated with (1), the aza-atom produced cyclic amides. Relative to isoquinoline, the methyl group in I and II deactivated the aza-aromatic ring to electrophilic ozone attack. Generally, initial nucleophilic ozone attack on aza-aromatic N-oxides led to cyclic hydroxamic acids and cleavage of the C=N aromatic bond (to nitroaldehydes) as primary products. With ozone as an electrophils, further ozonization of the former led to deoxygenated products, cyclic amides. Phthalic acid was also obtained from VIII and IX. In almost all cases, solvent effects were noted. N → O and C=O absorption frequencies of reactants and products are tabulated. (Contractor's abstract)

731

Fordham U. Dept. of Chemistry, N. Y.

PYROLYSIS AND PHOTOLYSIS OF 1-METHYL-3-DIAZOOXINDOLE. BASE DECOMPOSITION OF ISATIN 2-TOSYLHYDRAZONE, by E. J. Moriconi and J. J. Murray. [1964] [8]p. incl. diagrs. refs. (AFOSR-65-0374) (AF AFOSR-62-18) AD 611726
Unclassified

Also published in Jour. Org. Chem., v. 29: 3577-3584, Dec. 1964.

Pyrolysis of 1-methyl-3-diazooxindole (I) in refluxing ethanol led to 1,1'-dimethylisoindigo (II) and 1,1'-dimethylisatinazine (III), and in the presence of pyridine N-oxide produced II, III, and 1-methylisatin (IV). Photolysis of I in ethanol gave 3-ethoxy-1-methyloxindole (V); photolysis in cyclohexene led to two geometric cyclopropane isomers (VI and VII) resulting from cis addition to the cycloolefin, and in hexane solution containing 1,1-diphenylethylene produced the spirooxindole (VIII). Compounds II, IV, III, and V-VIII were probably formed by appropriate reaction with the pyrolytically and photolytically generated oxindolyene acting as a singlet. This same oxindolylene also displayed triplet character in the e.s.r. spectrum at 4°K, in reaction with oxygen to form IV, and with photolytically generated Cl· atoms and Cl_3C· free radicals (from CCl_4) to yield 3-chloro-3-trichloromethyl-1-methyloxindole. At room temperature, I reacted with bromine and triphenylphosphine to form 3,3-dibromo-1-methyloxindole and the phosphazine adduct (IX), respectively. Pyrolysis of IX led to the triphenylphosphine, II and III, but no ylide. (Contractor's abstract)

732

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

RESEARCH ON HIGH ENERGY PHYSICS INVESTIGATIONS USING NUCLEAR EMULSIONS, by M. A.

Pomerantz and D. F. Davis. Final rept. Feb. 1, 1961 - Jan. 31, 1963, 7p. (AFOSR-4999) (AF 49-(638)1023) AD 415118 Unclassified

Results of an experiment to measure the K meson total absorption cross section are reported. A stack of Ilford G5 emulsion 10 x 10 square centimeters in cross sectional area and 20 cm long was exposed to a beam of 1.3 bev/c K mesons. An effort was made to measure the variation in intensity of the K particles with distance along the beam by counting the number of their interactions. In the experiment a beam of pure K particles was produced at the target. (Contractor's abstract)

733

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

STUDY OF PROPERTIES OF MEDIUM-WEIGHT NUCLEI, by D. M. Van Patter, A. K. Sen Gupta, and R. Mohindra. Final rept. Nov. 1, 1962 - Oct. 31, 1963, 10p. (AFOSR-J1254) (AF AFOSR-62-217) AD 424350 Unclassified

The investigations were primarily concerned with the nuclear structure of the even-even nuclei Ni^{60}, Ni^{62}, Zn^{64} and Zn^{66}. The properties of their low-lying states were examined by the detection of γ-radiations produced during bombardment by protons with energies of about 4.4 to 5.1 mev provided by the Bartol-ONR Van de Graaff accelerators. For such incident energies the compound nucleus mechanism is expected to predominate. If, moreover, many compound states are excited, then one would expect statistical reaction theory to describe the reaction process. Therefore target thicknesses were deliberately chosen to be rather thick (about 150 kev) in order to average over at least one thousand compound states. The angular distributions of (p, p'γ) radiations resulting from inelastic proton scattering were of major interest for these experiments. These distributions, together with the absolute γ-ray production cross sections, were then compared with theoretical predictions using statistical reaction theory. (Contractor's abstract)

734

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

ZERO-SPIN ASSIGNMENT FOR THE 2.05-MEV STATE OF Ni^{62} FROM A (p, p'γ-γ) ANGULAR CORRELATION MEASUREMENT, by A. K. Sen Gupta and D. M. Van Patter. [1963] 4p. incl. diagrs. refs. (AFOSR-J1447) (AF AFOSR-62-217) AD 424350 Unclassified

Also published in Phys. Rev., v. 131: 318-321, July 1, 1963.

The γ-γ angular correlation of the 0.88-1.17-mev cascade, following excitation of the 2.05-mev state of Ni^{62} by the (p, p') reaction has been measured for angular separations of 90° to 180° at an average bombarding

energy of 4.71 mev. Convincing agreement was found with the correlation expected for a 0(Q)2(Q)0 cascade, thereby providing a unique zero-spin assignment for the second level of Ni^{62}. This assignment accounts for the measured isotropy (within ± 3%) of the 0.66-mev cascade transition with respect to the incident beam, as well as the lack of an observed ground-state transition. It is concluded that the measurement of a 0(Q)2(Q)0 γ-γ angular correlation following (p, p') excitation provides a promising method for the unique identification of zero-spin states in medium-weight even-even nuclei. (Contractor's abstract, modified)

735

[Franklin Inst.] Bartol Research Foundation, Swarthmore, Pa.

FILMS OF SEPARATED ISOTOPES BY VACUUM EVAPORATION, by P. N. Trehan. [1963] [2]p. incl. diagr. (AFOSR-65-0132) (AF AFOSR-62-217) AD 455967
Unclassified

Also published in Nuclear Instr. and Methods, v. 27: 471-472, 1963.

A method for preparing films of separated isotopes of Ni, Cr and Mo, by vacuum evaporation, is discussed. It is possible to prepare films of thickness varying from few $\mu g/cm^2$ to few mg/cm^2 on gold or platinum backing. (Contractor's abstract)

736

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

STUDIES OF THE LOW-LYING ENERGY LEVELS OF Zn^{64} AND Zn^{66} FROM MEASUREMENTS OF (p, p'γ) RADIATIONS, by A. K. Sen Gupta and D. M. Van Patter. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-0133) (AF AFOSR-62-217) AD 455735
Unclassified

Also published in Nuclear Phys., v. 50: 17-32, 1964.

An experimental investigation of the (p, p'γ) radiations from semi-thick targets of Zn^{64} and Zn^{66} has been carried out. Good agreement has been obtained for the angular distribution measurements, and level spins have been assigned on this basis. The measured cross sections, however, show some disagreement with theoretical values, which are particularly pronounced for the first 2^+ states in both Zn^{64} and Zn^{66}. The studies of the stronger γ-rays suggest the following levels and the spins and parities: Zn^{64}; 0.993(2^+), 1.604(2^+), 1.904(0^+), 2.321(4^+) and 2.616(0^+); Zn^{66}; 1.037(2^+), 1.865(2^+), 2.363(0^+) and 2.462(4^+?) mev. Some additional weaker γ-rays have also been observed in both the isotopes. The collective nature of the first 2^+ states in Zn^{64} and Zn^{66} being known, the (2, 0, 4) triplets that are seen in both these isotopes suggest that some kind of vibrational motion could account for these low-lying excited states. The present measurements

indicate that (p, p'γ) reaction studies provide a promising method for searching for such triplets in medium-weight even nuclei. (Contractor's abstract)

737

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

ON THE SECOND 2^+ LEVEL OF Ni^{56}, by S. M. Shafroth and G. T. Wood. [1964] [2]p. incl. diagr. (AFOSR-65-0620) (AF AFOSR-63-401) AD 616199
Unclassified

Also published in Compt. Rend. Cong. Internat'l. Phys. Nucleaire, Paris (France) (July 2-8, 1964) Paris, CRNS, v. 2: 476-477, 1964.

This note investigates the 2^+ level of Ni^{56} by studying the radiations from Cu^{56}, Ni^{60}, Ni^{62}, and Ni^{64}, all appear to show harmonic structure with two-phonon triplets, whereas Ni^{58} may be in a transitional region having some vibrational and some shell model properties. The study gives a measurement of δ, the E2/M1 mixing ratio for the $2^{+'} \to 2^+$ transition, which illuminates this point. Two window counters and a spectrum counter are used to record coincidence spectra.

736

Free U. of Brussels (Belgium).

[NEUROPHYSIOLOGICAL CORRELATES OF SENSORY PERCEPTION], by F. Bremer and J. E. Desmedt. Final rept. Dec. 1, 1956 - Dec. 31, 1962. Jan. 25, 1963, 12p. (AF 61(052)120) AD 632592
Unclassified

The contents of this report are: Corpus callosum; Neuropharmacology of cholinergic systems in the reticulo-cortical complex; Centrifugal control in auditory system; Auditory IV area; Analysis of mode of operation of the olivo-cochlear efferent axons; Effect of stimulation of reticular formation on cortical evoked potentials; Effect of chronic partial deafferentiation of cortical areas on their functional properties; Binocular interaction in visual cortex of cats; Cerebello-cerebral relations; Technical developments in the laboratory.

739

Free U. of Brussels (Belgium).

GENETIC REPLICATION AND MACROMOLECULAR SYNTHESES IN TEMPERATE BACTERIOPHAGES, by R. Thomas. Final technical rept. Sept. 30, 1963, 14p. (AFOSR-J1374) (AF EOAR-62-17) AD 428400
Unclassified

Superinfection experiments using chloramphenicol, or shift down to block protein syntheses, show that the early syntheses are not mutant-specific nor even species-specific. A number of conditional defective (suppressor sensitive, sus) mutants of λ have been

isolated and partly characterized by functional and recombinational analysis. The final purpose is to identify the genes involved in the early functions.

740

Free U. of Brussels (Belgium).

ON THE CONTROL OF THE REPLICATION OF TEM-
PERATE BACTERIOPHAGES SUPERINFECTING IM-
MUNE HOSTS, by R. Thomas and L. E. Bertani.
[1964] [13]p. incl. tables, refs. (AFOSR-65-2742)
(AF EOAR-62-17) AD 627766   Unclassified

Also published in Virology, v. 24: 241-253, Nov. 1964.

When lysogenic bacteria are superinfected with phage that is blocked by the immunity of the host and, at the same time, with a mutant (or a related heteroimmune phage) that is insensitive to the immunity of the host, as a rule, only the immunity-insensitive phage is capable of replicating. Those rare particles of immunity-sensitive type that are found in the progeny arise often (if not always) by recombination between the immunity-insensitive phage and either the superinfecting, immunity-sensitive phage or the prophage. Similar results have been obtained with two unrelated systems: the noninducible phage P2 (hosts: Escherichia coli C and Shigella dysenteriae) and the inducible phage λ (host: Escherichia coli K-12). These observations suggest that the genetic replication of a temperate phage in an immune host is blocked directly as a result of the interaction between an 'immunity substance' and the phage chromosome, rather than only indirectly, through repression of the synthesis of a diffusible 'initiator' necessary to initiate replication of the phage chromosome; or, alternatively, that the above-mentioned 'initiator' is not freely diffusible in the host cells. (Contractor's abstract)

741

Free U. of Brussels (Belgium).

ACTIVATION OF THE EFFERENT COCHLEAR BUN-
DLE IN THE PIGEON (Abstract), by J. E. Desmedt
and P. Delwaide. [1963] [1]p. (AFOSR-J844)
(AF EOAR-63-46) AD 416523   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35:
809, 1963.

An efferent cochlear bundle was demonstrated anatomically in the pigeon. Techniques have been developed for stereotaxic stimulation thereof in pigeons prepared under Fluothane anesthesia and immobilized by transection of cervical spinal cord plus injection of Flaxedil. Responses to tone pips or clicks were recorded oscillographically from the exposed round window. When the testing sounds are preceded by delivery of say, 30 shocks at 300/sec to the region of the efferent cochlear bundle close to the midline (histologically controlled), the cochlear microphonic (CM) potential is potentiated while the neural (N_1) spike is reduced. These effects were titrated as equivalent

dB changes in sound energy and they have not exceeded +6 dB equivalents for CM and -6 dB equivalents for N_1. Corresponding figures for the cat's olivocochlear bundle are +4 dB equivalents for CM and -25 dB equivalents for N_1. The marked contrast in potency for gating out neural responses evoked by sound in these two species raises questions about (1) behavioral significance of efferent bundle in birds, and (2) mode of action on the inner ear. (Contractor's abstract)

742

Free U. of Brussels (Belgium).

EXTRA-RETICULAR FEEDBACK CONNECTIONS IN
THE AUDITORY SYSTEM OF MAMMAL AND BIRD,
by J. E. Desmedt. Final scientific rept. Jan. 1 - Dec.
31, 1963. Jan. 28, 1964, 7p. (AFOSR-64-0734)
(AF EOAR-63-46) AD 436495   Unclassified

The mode of operation of several parts of the feedback control system related to acoustic input was investigated in acute experiments on cats and pigeons. New methods were developed, namely, procedures for spinal transection, stereotaxis, and control of the physiological status of the preparation in the pigeon experiments. The type of control exerted by the crossed olivo-cochlear bundle (OCB) of the cat on the transduction of sound waves into nerve impulses in the inner ear was examined. It was shown that OCB-conditioned responses to click present a peculiar latency-voltage relation and this phenomenon has a number of implications relevant to sensory processing. The functional properties of the uncrossed OCB were demonstrated for the first time. The uncrossed fibers exert inhibitory effects on the input and their parameters of activity and neurochemical properties have been investigated. In the pigeon the efferent cochlear bundle (ECB) described by Boord in 1961 was shown to suppress auditory nerve activity and potentiate the cochlear microphonic. While this system appears homologous to the OCB system described by Rasmussen in mammals, it differs significantly in several respects.

743

Free U. of Brussels (Belgium).

THEORY OF FREEZING, by R. Brout. [1963] [16]p.
incl. diagrs. refs. (AFOSR-64-1960) (AF EOAR-63-
51) AD 452429   Unclassified

Also published in Physica, v. 29: 1041-1056, 1963.

A theory of freezing is first developed from the point of view of molecular field theory. The fundamental approximation is thus the neglect of the enhancement of fluctuations before freezing. Two methods are developed. The first makes use of the information gained by crystallization by calculating the entropy change through information theory. The second is based on more fundamental methods of statistical mechanics. A value is found for the freezing point at fixed density. It is then shown that the sum on ring diagrams in a cluster expansion in the medium of a hard sphere

fluid presents singularities both for freezing and condensation. The condensation singularity is suppressed by the mechanism of condensation into the liquid phase, whereas a further singularity corresponding to freezing is not so suppressed. This singularity occurs at exactly the same temperature as that quoted above. In this way, one has a theory of critical fluctuation in freezing corresponding to that of Ornstein and Zernike in the case of condensation. The relation to a dielectric formalism is indicated.

744

Free U. of Brussels (Belgium).

BROKEN SYMMETRY AND THE MASS OF GAUGE VECTOR MESONS, by F. Englert and R. Brout. 1964, 3p. incl. refs. (AFOSR-65-0097) (AF EOAR-63-51) AD 455984   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 321-323, Aug. 31, 1964.

It is shown that in certain cases vector mesons do indeed acquire mass when the vacuum is degenerate with respect to a compact lie group.

745

Free U. of Brussels (Belgium).

A POSSIBLE THEORETICAL ARGUMENT WHICH ELIMINATES THE (HITHERTO) UNREALIZED REPRESENTATIONS OF SU(3), by F. Englert and R. Brout. [1964] [2]p. (AFOSR-65-0098) (AF EOAR-63-51) AD 455983   Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 682-683, June 15, 1964.

Lagrangians invariant under the direct product of the baryon gauge group and SU(3) are invariant under the smaller group U(3). Only certain representations of U(n) are factorizable into representations of the baryon gauge group and another group which realizes the adjoint group of SU(n). The general form of allowed direct products in the factorized representation is given for n = 3. Applications to physical models including the Sakata model are discussed. The use of U(3) and strict baryon conservation would eliminate the hitherto physically unrealized representations of SU(3).

746

Free U. of Brussels (Belgium).

NATURE OF THE CRYSTALLINE SOLID AT ELEVATED TEMPERATURES, by R. Brout, S. Nettel, and H. Thomas. [1964] [3]p. incl. diagrs. (AFOSR-65-0418) (AF EOAR-63-51) AD 612521
                                        Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 474-476, Oct. 12, 1964.

Some calculations based on Brout's theory of freezing (Physica, v. 29: 1041, 1963) indicate that the single-particle density distribution for a molecular solid behaves much like that for a liquid for temperatures well below the freezing point, but well above the Debye temperature.

747

Free U. of Brussels (Belgium).

RESPONSE FUNCTIONS, SUPERCONDUCTIVITY AND FERROMAGNETISM IN THE MANY FERMION SYSTEM, by H. Stern and R. Brout. [1964] [24]p. incl. diagrs. refs. (AFOSR-65-0419) (AF EOAR-63-51) AD 612317   Unclassified

Also published in Physica, v. 30: 1689-1712, 1964.

At the phase transition, the anomalies of thermodynamic and static response functions coincide due to the fact that the free energy, expressed in terms of response functions at imaginary frequency including zero, has its pole at zero frequency. In this paper, a study is made of the divergences arising from the modification of the vertex function. The diamagnetic current is related to the free energy via the Ward Identity so that the specific heat anomaly inevitably gives rise to the Meissner effect. Below the transition the system adjusts to the singularity by going into the BCS condensed state. The similarity between BCS theory and ferromagnetism is shown through a Weiss field approach and diagrammatically by including special correlations between k and -k. Its importance for an understanding of the broken symmetry problem is discussed. Finally, the parallel behavior of the susceptibility and specific heat of a Bloch ferromagnet is demonstrated. (Contractor's abstract)

748

Free U. of Brussels (Belgium).

HIGH PLEIOTROPY OF STREPTOMYCIN MUTATIONS IN ESCHERICHIA COLI, by M. Couturier, L. Desmet, and R. Thomas. [1964] [5]p. incl. tables. (AFOSR-64-1714) (AF EOAR-64-10) AD 448262
                                        Unclassified

Also published in Biochem. and Biophys. Research Commun., v. 16: 244-249, 1964.

Bacteria mutants selected for their resistance to streptomycin (resistant Smr, or dependent Smd) frequently manifest characters which have no obvious relation with the Smr or Smd character itself. This report discusses the highly pleiotropic character of many Smr mutation in E. Coli K 12, strain C600. This pleiotropy is in some ways similar to that of allele-specific supersuppressors, and it is shown that most Smr (or Smd) derivatives of C600 express three new characters and there is a complete correlation in that each strain expresses either all three or none.

749

Free U. of Brussels (Belgium).

GENETIC REPLICATION AND MACROMOLECULAR
SYNTHESES IN TEMPERATE BACTERIOPHAGES, by
R. Thomas. Final rept. Oct. 1, 1964, 8p. (AFOSR-
64-2231) (AF EOAR-64-10) AD 608793
Unclassified

Experiments involving mixed superinfection of lyso-
genic bacteria with an homologous phage and an im-
munity-insensitive mutant show that the repressor of
immunity blocks altogether transcription and replica-
tion directly. A new method allows (a) preferential
isolation of those conditional defective mutations which
affect early functions and (b) isolation of sus mutants
which are well corrected by bacterial suppressors.
There is direct evidence for Spotts and Stanier's hy-
pothesis that the bacterial gene controlling the response
to streptomycin is involved in the determination of the
structure of ribosomes. Many streptomycin-resistant
mutants (which are now known to be altered in the
structure of their ribosomes) behave much as pleio-
tropic suppressors. The exact structure of ribosomes
probably contributes to the specificity of the transla-
tion process.

750

Free U. of Brussels (Belgium).

[CONTRASTS BETWEEN CENTRAL ACTIONS OF
CONIINE AND STRYCHNINE] Contrastes entre les
actions centrales de la coniine et de la strychnine, by
V. La Grutta and J. E. Desmedt. [1964] [8]p. incl.
illus. (AFOSR-65-0309) (AF EOAR-64-10) AD 612318
Unclassified

Also published in Arch. Internat'l. Pharmacodyn.
et Ther., v. 151: 289-296, 1964.

The action of coniin or hemlock alcaloid has been
analyzed in the cat and in the pigeon with the spinal
cord transected at C_2 and immobilized with Flaxedi(R).
The intravenous injection of 40-60 mg/kg coniin elicits
convulsive hypersynchronous activity in the telencepha-
lon but does not modify the spontaneous electrical
activity of the spinal cord. These effects contrast with
those of strychnine which, in similar preparations,
elicits convulsions restricted to the spinal cord.
Furthermore the liminal doses of coniin are similar
in pigeon and cat, whereas strychnine is about 20 times
less active in the pigeon than in the cat. Coniin also
antagonizes the olivo-cochlear post-synaptic inhibition
without modifying the response evoked by sound in the
auditory nerve. Coniin is thus the first drug, besides
strychnine and brucine, shown to depress this inhibi-
tion. Significant differences namely in the intensity and
rapidity of the antagonism suggest that the mode of ac-
tion of coniin differs from that of strychnine. The in-
terest of the tests used for the screening of strychnine-
like actions is stressed. (Contractor's abstract)

751

Free U. of Brussels (Belgium).

[ANALYSIS OF SOMESTHETIC EVOKED POTEN-
TIALS IN MAN] Analyse des potentiels évoqués
somesthésiques chez l'homme (Abstract), by J.
de Becker, J. Manil, and J. E. Desmedt. [1964] [1]p.
(AFOSR-66-0773) (AF EOAR-65-57) AD 632902
Unclassified

Also published in Rev. Neurol., v. 112: 255, 1964.

The components of parietal evoked potentials have been
analyzed by systematically correlating the evoked re-
sponses to digital stimuli of varying intensities or fre-
quencies. The authors have been able to evoke given
components preferentially because of their low thresh-
olds or tendency to follow higher frequencies of stimu-
lation. The threshold and characteristics of the evoked
potential components may be defined by the curve show-
ing the percentage of shocks perceived at a certain
stimulus intensity.

752

Free U. of Brussels. [Dept. of Chemical Physics]
(Belgium).

CONTRIBUTIONS IN NON-EQUILIBRIUM STATISTICAL
MECHANICS AND THERMODYNAMICS, by I.
Prigogine. Final technical rept. Dec. 1961 - June
1964. June 30, 1964. 224p. incl. diagrs. refs.
(AFOSR-65-1059) (AF EOAR-62-16) AD 617790
Unclassified

Apart from a thermodynamic study of the hydromag-
netic stability problem for a system far from equilib-
rium, the essential matter of this report consists in a
number of applications and extensions of the general
statistical mechanical theory of irreversible processes
previously developed. Generalized kinetic equations
are obtained for non-uniform systems as for systems
in external fields of arbitrary strength. The resulting
expressions for the transport coefficients are analyzed
and shown to be equivalent, at all orders in a perturba-
tion expansion, to the forms obtained from the auto-
correlation function formulas. The latter are further
discussed for the quantum case, for which an extension
of the kinetic approach is also outlined. In the field of
classical plasma physics, the study of an unstable plas-
ma has exhibited the stabilization mechanism associated
to the correlations, and the equation for an inhomogene-
ous plasma far from equilibrium has been derived.
Finally, a rigorous statistical mechanical formulation
is given for the hydrodynamics of a relativistic plasma.

753

Free U. of Brussels. [Dept. of Chemical Physics]
(Belgium).

THERMODYNAMICS OF SPIN SYSTEMS IN SOLIDS, by
J. Jeener, H. Eisendrath, and R. Van Steenwinkel.
[1964] [13]p. incl. diagrs. refs. (AFOSR-65-1082)
(AF EOAR-62-16) AD 618438   Unclassified

Also published in Phys. Rev., v. 133: A478-A490, Jan. 20, 1964.

Quasiequilibrium states of the spin system in a solid are described in terms of one Zeeman temperature for each spin species plus one dipole-dipole temperature, T_D. Energy and entropy are calculated and used to predict the steady state of processes such as cross relaxation. It is predicted and demonstrated by an experiment on the nuclear spins in LiF that the state of the dipole-dipole system has a strong influence on such steady states. Continuous wave and pulse spectroscopy are discussed for systems with low T_D. Techniques are proposed to measure T_D and one Zeeman temperature simultaneousiy, using coherent pulse instrumentation, and for preparing a state of iow T_D in a large magnetic field by complete adiabatic demagnetization followed by sudden magnetization. A density matrix formalism is proposed for the description of quasiequilibrium situations in the case of spins with unequally spaced energy levels. Finally the influence of the nonsecular part of the spin-spin Hamiltonian on the quasi-equilibrium states is estimated by a perturbation calculation, and the resulting description inciudes the cases of low- or zero-magnetic field and partly or completely overlapping absorption lines. (Contractor's abstract)

754

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

KINETIC EQUATION FOR AN INHOMOGENEOUS PLASMA FAR FROM EQUILIBRIUM, by R. Balescu and A. Kuszell. [1964] [10]p. incl. diagrs. refs. (AFOSR-65-2778) (AF EOAR-62-16) AD 627939
Unclassified

Also published in Jour. Math. Phys., v. 5: 1140-1149, Aug. 1964.

A kinetic equation for a nonuniform plasma is derived from the Liouville equation by a generai diagram technique. It describes the evolution of a small spatial inhomogeneity in a plasma whose velocity distribution is far from equilibrium (ano nence time-dependent). The equation is valid for short and long times, within the ring approximation. Its explicit form is obtained by the exact ciosed solution of a singular integrai equation. The kinetic equation is non-Markoffian and, contrary to the corresponding homogeneous equation, keeps a trace of this character even in the limit of long times. Only when the velocity distribution and the two-body correlation function reach thermal equilibrium does the equation reduce to a Markoffian limit. The latter is identical with the kinetic equation derived earlier by Guernsey. The treatment of unstable inhomogeneous plasmas is briefly indicated. (Contractor's abstract)

755

Free U. of Brusseis. [Dept. of Chemical Physics] (Belgium).

TRANSPORT EQUATION OF A BROWNIAN PARTICLE IN AN EXTERNAL FIELD, by P. Resibois and H. '. Davis. [1964] [15]p. (AFOSR-65-2677) (AF EOAR-62-16) AD 628373
Unclassified

Also published in Physica, v. 30: 1077-1091, 1964.

The generai theory of irreversible processes developed by I. Prigogine and coworkers is applied to the particular problem of the motion of a heavy charged particle (mass M) moving in a fluid of light particles under the influence of an externai electric field. The results obtained recently by J. Lebowitz and E. Rubin are recovered using a compieteiy different technique; to the iowest order in γ the Brownian particle obeys a Fokker-Planck equation. The higher order corrections are aiso discussed and special attention is focused on the effect of the field during a collision process between the Brownian particie and the fluid: thie effect can, however, be incorporated in a veiocity dependent correction to the Fokker-Planck collision term. (Contractor's abstract)

756

Free U. of Brusseis. [Dept. of Chemical Physics] (Belgium).

KINETIC EQUATIONS AND STATIONARY STATE FOR A SYSTEM IN A UNIFORM EXTERNAL FIELD, by G. Severne. [1964] [24]p. incl. refs. (AFOSR-65-2881) (AF EOAR-62-16) AD 628374
Unclassified

Also puolished in Physica, v. 30: 1365-1366, 1964.

In an extension of the formalism deveioped by I. Prigogine and his collaborators, the generaiized equations of evolution are derived for a system in the presence of an external field. of arbitrary strength and time dependence, but uniform in space. The basic new feature of both the non-Markoffian and the asymptotic equations consists in the fieid dependence of the collision term. The explicit form of these fieid corrections is worked out for a simplified description of a plasma in a constant eiectric field, and the limit of vaiidity of the usual kinetic equatiors is specified. The generalized equation of evolution introduces a corrective term iinear in the eiectric field which, for the stationary state, is precisely such as to ensure the complete equivaience with the linear response function formulation of the stationary state, i..e. with the Kubo formula. (Contractor's abstract)

757

Free U. of Brussels. Lab. of Animai Morphology (Belgium).

[EFFECTS OF α-LIPOIC ACID ON NUCLEIC ACID METABOLISM IN AMPHIBIAN AND CHICKEN EMBRYOS] Effets de l acide α-lipoïque sur ie metabolisme

des acides nucleiques chez les embryons de batraciens et de poulet, by V. Heilporn-Pohl and J. Quertier. [1963] [20]p. (AFOSR-65-2243) (AF 61(052)356) AD 629462　　　　　　　　　　Unclassified

Also published in Develop. Biol., v. 9: 155-175, Apr. 1964.

Both the oxidized and the reduced forms of lipoic acid inhibit neural tube closure in pleurodeles and in chicken embryos. Oxidized lipoic acid inhibits the incorporation of H3-uridine and H3-cytidine into DNA; it inhibits the stage which involves the reduction of the ribonucleosides to the deoxyribonucleosides: in fact, the incorporation of H3-deoxyuridine is little or not all affected by this substance. The action of reduced lipoic acid and reduced triphosphopyridine nucleotide on the reduction of ribose to deoxyribose is just the opposite of that exerted by oxidized lipoic acid. The addition of TPNH to oxidized lipoic acid prevents the inhibition of the incorporation of the ribonucleosides normally observed with oxidized lipoic acid. (Contractor's abstract)

758

Free U. of Brussels. [Lab. of Animal Morphology] (Belgium).

ROLE OF SULFHYDRYL AND DISULFIDE GROUPS IN MORPHOGENESIS, by J. Brachet. Final rept. Apr. 1, 1962 - Apr. 30, 1963. May 31, 1963, 10p. (AFOSR-4852) (AF EOAR-61-31) AD 413860　　　　　　　　　　　　　　　Unclassified

A study was conducted to compare the morphostatic effects of mercaptoethanol and α-lipoic acid on amphibian eggs, chick embryos, nucleate and anucleate fragments of the giant unicellular alga Acetabularia mediterranea. The organisms treated with mercaptoethanol or lipoic acid, as well as lethal hybrids between amphibians, were subjected to substances such as ATP and Krebs cycle substrates to obtain, if possible, a resumption of morphogenesis. (Contractor's abstract)

759

Free U. of [West] Berlin (Germany).

RESEARCH ON CLUSTERING OF GALAXIES, by R. Wielen. Jan. 1963, 34p. (Technical rept.) (AFOSR-4753) (AF 61(052)335) AD 408301　　Unclassified

According to the contract the following studies on clustering of galaxies have been planned: (1) The existence and evolution of superclusters should be proved. Therefore statistical methods must be applied to the existing catalogue of clusters. The theoretical foundation has been developed by Dr. Just. His results are given in the appendix. (2) The richness distribution of clusters of galaxies should be the subject of the second part of the investigations. Especially the influence of systematic and random errors on the richness-distribution should be studied.

760

Free U. of [West] Berlin (Germany).

SOME REMARKS ON THE POSITION OPERATOR IN IRREDUCIBLE REPRESENTATIONS OF THE LORENTZ-GROUP, by W. Weidlich and A. K. Mitra. [1963] 14p. (AFOSR-64-0284) (AF EOAR-62-66) AD 431494　　　　　　　　　　Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 385-398, Oct. 10, 1963.

The form of the position operator for relativistic particles in different spinor bases is derived and its uniqueness is proved. The transformation properties of the position operator under all Lorentz transformations and their physical meaning are considered. (Contractor's abstract)

761

Free U. of [West] Berlin (Germany).

RESEARCH ON VOLUME CONDITIONED STIMULI AFFECTING SALT AND WATER EXCRETION, by O. H. Gauer. Final rept. Oct. 1, 1962 - Jan. 31, 1964. Mar. 15, 1964, 4p. (Rept. no. 2) (AFOSR-64-0992) (AF EOAR-62-75) AD 600342　　　　　　　　　　　　　　　　Unclassified

Humoral effects and changes of renal hemodynamics during left atrial distension, competition of osmotic and volume conditioned stimuli in trained animals and the effect of body water immersion on plasma volume and a diuretic factor in the plasma were investigated. Results are given. (Contractor's abstract)

762

Free U. of [West] Berlin (Germany).

[THE EFFECT OF ADH ON IMMERSION DIURESIS] Die Beeinflussung der Badediurese durch Adiuretin, by P. Eckert. [1964] 1p. (AFOSR-65-2842) (AF EOAR-65-63) AD 629211　　　　　　Unclassified

Also published in Arch. Ges. Physiol., v. 281: 1964.

Immersing human subjects in a neutral-temperature water bath for several hours generally triggers a diuresis accompanied by a considerable increase in water clearance. In order to study the efferent mechanism of this diuresis, four subjects were tested to determine whether and under what circumstances diuresis was inhibited by ADH. The following results were obtained: Immersion diuresis was reduced to original diuretic levels by injections of ADH (0.5-1.0 milli-units/kg), just as a comparable polyuria caused by water-drinking was decreased. In addition continuous ADH infusion (0.25 milli-units/kg/30 min.) completely blocked the onset of immersion diuresis. These results are in agreement with the hypothesis that inhibition of ADH-secretion plays an important part in immersion diuresis.

763

Free U. of [West] Berlin (Germany).

[THE EFFECT OF SHORT-TERM OCCLUSION OF THE PORTAL VEIN ON DIURESIS AND ARTERIAL BLOOD PRESSURE IN THE UNANESTHETIZED RAT] Über den Einfluß kurzzeitiger Abklemmung der Vena portae auf die Diurese und den arteriellen Blutdruck der wachen Ratte, by F. J. Haberich, O. Aziz, and P. E. Nowacki. [1964] 1p. (AFOSR-65-2843) (AF EOAR-65-63) AD 629210   Unclassified

Also published in Arch. Ges. Physiol., v. 281: 1964.

Arterial cannulae were implanted in rats for blood pressure measurements, and inflatable cuffs were implanted around the portal vein. The animals were lightly intoxicated with ether, hydrated, and catheterized. After a short control period the portal vein was occluded for 20-60 sec. Beginning 30-60 sec after the onset of occlusion, the blood pressure fell 20-50 mm Hg and remained low for 1-2 min. Occlusion for 30 sec or longer caused diuresis to stop for several min (anuric phase) and remain decreased for 20-30 min (antidiuretic phase). The diuresis returned to its original level in 30-40 min. Occlusion for 20 sec or less had only a weak anti-diuretic effect. This phenomenon cannot be explained by the short-term fall in the blood pressure. It is probably due to a massive outpouring of ADH, since the blood exhibits strong anti-diuretic activity during the decreased diuresis.

764

Free U. of [West] Berlin (Germany).

[THE DIFFERENT DIURETIC EFFECTS OF WATER AND ISOTONIC SALINE INFUSION INTO THE PORTAL VEIN AND VENA CAVA OF THE UNANESTHETIZED RAT] Über das unterschiedliche Verhalten der Diurese bei intraportalen und intracavalen Infusionen von Wasser und 0,9% NaCl-Lösung an der wachen Ratte, by F. J. Von Haberich, O. Aziz, and P. E. Nowacki. [1964] 1p. (AFOSR-65-2964) (AF EOAR-65-63) AD 628372   Unclassified

Also published in Arch. Ges. Physiol., v. 279: 1964.

Fine cannulae were implanted in the portal vein and inferior vena cava of female rats so that normal blood flow was not disrupted during the month-long experimental period. Solutions at physiological temperature were infused at a constant rate (3ml/hr). Diuresis was measured by catheterization. When distilled water was infused for a short time (20 min equal to 1 ml), only the portal route resulted in an increased diuresis (up to 180%). Water infusion for an hour by the two different routes was distinguished by the latency period prior to the onset of diuresis and by the maximum diuretic values. The differences were statistically significant (p less than 0.01 or p less than 0.05). A one-hour infusion of 0.9% NaCl (3 ml/hr the portal route led to no rise in diuresis, while the caval infusion produced a distinct increase. These findings show that an osmotic stimulus in the region

of the portal vein or liver triggers a response that leads to an increase in diuresis.

765

Free U. of [West] Berlin (Germany).

[A HUMORAL FACTOR RESPONSIBLE FOR IMMERSION DIURESIS] Untersuchungen zur Frage der humoralen Auslösung der Badediurese, by H. J. Linkenbach, D. Kaiser and others. [1964] 1p. (AFOSR-65-2965) (AF EOAR-65-63) AD 627952
                                          Unclassified

Also published in Arch. Ges. Physiol., v. 279: 1964.

Diuresis was induced in human subjects by maintaining them in a horizontal position and/or immersing them in a neutral-temperature water bath, and their sera were tested for diuretic activity on alcohol-anesthetized rats. The sera from "Fasting-sitting" subjects usually showed no or very slight anti-diuretic effect, but the sera from the horizontal and immersed subjects caused a 20-80% increase in diuresis. A quantitative relationship between this rise in diuresis and the subject's urine volume at the time of blood withdrawal was not found. After standing at room temperature for 20 hrs, the diuretic immersion serum usually showed a considerably decrease in efficacy (ranging to total loss of effectiveness), while its effect was generally preserved after standing at 2-4°C for the same length of time. This probably implies the participation of a thermolabile diuretic substance in immersion diuresis.

766

Fulmer Research Inst., Ltd., Stoke Poges, Buckinghamshire (Gt. Brit.).

STABILITY OF LOWER BORON HALIDES, by P. Gross, C. Hayman and others. Final technical rept. Aug. 22, 1963, 46p. (Rept. no. 154/12) (AFOSR-J1463) (AF 61(052)405) AD 426428   Unclassified

Boron is transported in a stream of boron trifluoride as lower boron fluoride between 1100 and 1400°C. The transport at 1 atm corresponds to 0.1 to 0.5% conversion to monofluoride, for whose standard heat of formation a value of -28 ± 3 kcal is estimated. The experiments show that simultaneously another lower boron fluoride is formed.

767

Fulmer Research Inst., Ltd., Stoke Poges, Buckinghamshire (Gt. Brit.).

HEATS OF FORMATION OF α'-BERYLLIUM CHLORIDE AND α- AND β-BERYLLIUM NITRIDE, by P. Gross, C. Hayman and others. Sept. 1964 [20]p. incl. illus. diagrs. tables, refs. (Rept. no. R 163/SR 1) (AFOSR-66-0344) (AF 61(052)447) AD 630633
                                          Unclassified

The heat of formation of α'-BeCl$_2$(s), [$\Delta H°_{f298}$

(α'-BeCl$_2$) = -117.1 ± 0.4 kcal], of α-Be$_3$N$_2$ [ΔH°_{f298} (α-Be$_3$N$_2$) = -141.0 ± 1.6 kcal] and of β-Be$_3$N$_2$ [ΔH°_{f298} (β-Be$_3$N$_2$) = -136.7 ± 1.5 kcal] have been determined by combustion of the metal and the nitrides in Cl$_2$. A value ΔH°_{f298} α-Be$_3$N$_2$ = -140.5 ± 0.3 kcal has been obtained by reaction of the metal with NH$_3$.

768

Fulmer Research Inst., Ltd., Stoke Poges, Buckinghamshire (Gt. Brit.).

HEATS OF FORMATION OF COMPOUNDS CONTAIN-

ING B, Be, Al AND Li, by P. Gross. Final rept. Dec. 31, 1964, 5p. (Rept. no. R 163/18) (AFOSR-65-1048) (AF 61(052)447) AD 470919   Unclassified

A brief review of the work performed is presented. A preliminary value ΔH_{f298} = +27.4 ± 5.8 kcal is derived for the heat of combination of the oxides in 9Al$_2$O$_3$ · 2B$_2$O$_3$. Measurements on the heat of solution of Al$_2$O$_3$ · Li$_2$O have been made. X-ray powder photographs of Li$_3$ AlF$_6$ in a wide temperature range indicate the existence of five forms of the compound designated α, β, γ, δ, and ϵ in order of stability at increasing temperatures. The heat of the reaction 2LiF (crystal) + BeF$_2$ (glass) = Li$_2$ BeF$_4$ (crystal) is measured to be ΔH°_r = -5.3 ± 0.5 kcal.

769

Galway U. [Dept. of Chemistry] (Ireland).

SPECTRAL PROPERTIES OF THE PHYCOBILINS. II. PHYCOERYTHROBILIN, by P. O'Carra, C. OhEocha, and D. M. Carroll. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0035) (AF 61(052)409) AD 454660
Unclassified

Also published in Biochem., v. 4: 1343-1350, Sept. 1964.

The bile pigment phycoerythrobilin, isolated from phycoerythrins, is shown to be a chemically unaltered prosthetic group of these biliproteins. Additional properties and reactions of phycoerythrobilin have been determined and a bilidiene $IX\alpha$ structure, isomeric with mesobiliviolin $IX\alpha$, is proposed for it. Such a structure has been erroneously associated in the past with a pigment preparation termed mesobilirhodin, and a pigment isolated R-phycoerythrin. This latter, which was originally regarded as phycoerythrobilin, is shown to have been a urobilinoid artifact of the native prosthetic group. Phycoerythrobilin is isomerized by concentrated HCl to a mesobiliviolin and a urobilin which differs from i- and d-urobilin in that it forms refractory covalent linkages with thiol compounds, including the apoprotein of phycoerythrins. A pigment obtained from d-urobilin by isomerization is closely related to phycoerythrobilin, though not identical with it, and the two pigments are considered to be side-chain isomers. (Contractor's abstract)

770

Galway U. [Dept. of Chemistry] (Ireland).

STRUCTURAL AND BIOSYNTHETIC STUDIES OF THE PHYCOBILINS, by C. ÓhEocha. Final technical rept. Aug. 29, 1963, 19p. (AFOSR-J1171) (AF EOAR-62-36) AD 422696
Unclassified

A survey was made of the biliproteins of cryptomonad algae. Structural studies of the phycobins of R-phycoerythrin are reported; one of these was obtained in a pure state from C-phycocyanin. The fluorescence spectra of R-phycocyanin are discussed.

771

Galway U. [Dept. of Chemistry] (Ireland).

BILIPROTEINS OF CRYPTOMONAD ALGAE, by C. ÓhEocha, P. O'Carra and D. Mitchell. [1964] [10]p. (AFOSR-64-1176) (AF EOAR-62-36) AD 442635
Unclassified

Also published in Proc. Roy. Irish Acad., v. 63: 191-200, 1964.

Phycoerythrins and phycocyanins have been isolated and characterized from eight species of cryptomonads (Division Cryptophyta, Class Cryptophyceae, Order Cryptomonadales). Their absorption spectral characteristics are compared with those of previously described cryptomonad biliproteins. Fluorescence spectra of cryptomonad biliproteins are recorded for the first time. Denaturation and hydrolysis studies of phycocyanins from cryptomonads indicate that they contain two dissimilar colored prosthetic groups, or chromophores, one of which has been identified with the pigment of C-phycocyanin.

772

General Applied Science Labs., Inc., Westbury, N. Y.

EXPERIMENTAL SOUND FIELD DISTRIBUTIONS OF A JET WITH A STATIONARY ACOUSTIC SOURCE, by S. Slutsky. May 1963, 19p. incl. illus. diagrs. (Technical rept. no. 351) (AFOSR-5322) (AF 49(636)-194) AD 417281; AD 418381
Unclassified

Measurements are made in the far field of an axisymmetric jet using a non-convecting ultrasonic source located on the jet axis. Reasonable comparisons are found with the results of an analytic model based on parallel flow and boundaries. Experiments were then carried out on a water table in which a two dimensional configuration was simulated under conditions of parallel steady jet flow, and of wavy jet flow. The results confirmed indications that the wavy flow in a jet is responsible for the diffusion of sound field directionality.

773

General Applied Science Labs., Inc., Westbury, N. Y.

LINEARIZED VISCOUS FREE MIXING WITH STREAMWISE PRESSURE GRADIENTS, by M. H. Steiger and M. H. Bloom. [1964] [4]p. incl. diagr. refs. (AFOSR-64-0910) (AF 49(636)991) AD 439665
Unclassified

Also published in AIAA Jour., v. 2: 263-266, Feb. 1964.

Sets of similar solutions applicable within a linearized approximation are derived for two-dimensional compressible and axisymmetric incompressible viscous free mixing with streamwise pressure gradients. Viewed as eigenfunctions these solutions can be superposed to represent arbitrary initial conditions. However, it is observed that only one solution of the family possesses a net momentum defect (or excess) different from zero. This mode decays exponentially in the normal direction and has a stronger streamwise persistence than any of the other solutions that have exponential normal decays; it is usually referred to as the similar solution. (Contractor's abstract)

774

General Applied Science Labs., Inc., Westbury, N. Y.

REVIEW OF PROBLEMS IN APPLICATION OF SUPERSONIC COMBUSTION, by A. Ferri. May 14, 1964 [107]p. incl. diagrs. table, refs. (AFOSR-64-1471) (AF 49(636)991) AD 604441
Unclassified

Presented at Seventh Lanchester Memorial Lecture, Royal Aeronautical Soc., London (Gt. Brit.). May 14, 1964.

Also published in Jour. Roy. Aeronaut. Soc., v. 68: 575-597, Sept. 1964. (AFOSR-64-2387; AD 451878)

The problem of air-breathing engines capable of flying at very high Mach numbers is described briefly. Possible performance of supersonic combustion ramjets is outlined briefly and the supersonic combustion process is described. Two mechanisms of combustion are outlined: one is supersonic combustion controlled by convection process, and the second is controlled by diffusion. The parameters related to the combustion process are discussed in detail. Data and analyses of reaction rates and mixing phenomena are represented; the flame mechanism is discussed, and experimental results are presented.

775

General Applied Science Labs., Inc., Westbury, N. Y.

AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF IGNITION AND AXI-SYMMETRIC TURBULENT FLAME PROPAGATION IN HYDROGEN-AIR MIXTURES AT SUPERSONIC SPEEDS, by J. Tamagno and N. Trentacoste. July 1964, 69p. incl. illus. diagrs. table, refs. (Technical rept. no. 445) (AFOSR-64-1472) (AF 49(638)991) AD 604429
Unclassified

The report is concerned with the experimental study of turbulent combustion processes in high speed flows and the comparison of the experimental results with those obtained by means of a newly available numerical approach for the computation of flows with diffusion and finite rate chemistry. It is shown that stable ignition may be insured in a jet of hydrogen-air or ethylene-air mixture by a pilot flame of small dimensions and very low heat liberation compared to that of the main stream (of the order of 0.4%). Under proper conditions the premixed jet is ignited without fluctuations, periodic flashes or oscillations. A strong dependence of the flame propagation velocity on the mixture composition has been found experimentally for given constant flow conditions, i.e., flow velocity and total temperature of the mixture. This dependence correlated well with the predictions of the numerical computations.

776

General Applied Science Labs., Inc., Westbury, N. Y.

LINEARIZED APPROXIMATIONS TO THE BOUNDARY LAYER EQUATIONS, by J. A. Schetz and J. Jannone. June 1964, 74p. (Technical rept. no. 448) (AFOSR-64-1473) (AF 49(638)991) AD 604430 Unclassified

The general subject of linearized approximations to the boundary layer equations as a source of approximate solutions for viscous flow problems is considered from a unified viewpoint. The various methods based upon this concept which have been proposed in the

literature are reviewed and applied to two specific non-similar flow problems in order to affect a comparison of quantitative results. Within this framework some new work is presented. Linearization in the von Mises plane is considered in some detail, and typical results are compared with those obtained by the conventional physical plane linearization techniques. In this regard, the use of the total pressure rather than the velocity as the dependent variable is shown to have important advantages, both conceptual and quantitative, even for constant pressure flow problems when subjected to a linearized treatment. Finally, specific recommendations are made as to the approach best applied to a specific type of physical problem.

777

General Applied Science Labs., Inc. [Westbury] N. Y.

SUPERSONIC COMBUSTION PROGRESS, by A. Ferri. [1964] [7]p. (AFOSR-64-1953) (AF 49(638)991) AD 450318   Unclassified

Also published in Astronaut. and Aeronaut., v. 2: 32-37, Aug. 1964.

A ramjet is presented using supersonic combustion controlled by mixing which appears to be of great interest, because such a scheme promises very good performances for a large Mach-number range without the necessity of variable-geometry inlets and variable-geometry nozzles.

778

General Applied Science Labs., Inc., Westbury, N. Y.

INITIAL BOUNDARY LAYER EFFECTS ON LAMINAR FLOWS WITH WALL SLOT INJECTION, by J. A. Schetz and J. Jannone. [1963] [4]p. (AFOSR-64-2478) (AF 49(638)991) AD 453963   Unclassified

Also published in Jour. Heat Transfer, 1964, p. 1-4.

An analytical investigation of the effects of an initial splitter plate boundary layer on the flow field associated with the slot injection of a gas in laminar flow is presented. The analysis is based on the method of collocation, using profiles generated by a modified Oseen approximation to the momentum equation, and the results are presented in terms of the effects on skin friction and heat transfer coefficients. It is shown that the initial boundary layer thickness can be an important parameter in describing the flow field.

779

[General Applied Science Labs., Inc., Westbury, N. Y.]

MIXING PROCESSES IN SUPERSONIC COMBUSTION, by A. Ferri, G. Moretti, and S. Slutsky. [1965] [59]p. incl. diagrs. refs. (AFOSR-65-1310) (AF 49(638)991) AD 619390   Unclassified

Presented at Symposium on Appl. Math. and Mech.,
Washington, D. C., May 11-14, 1964.

The problem of combustion and mixing of fuel and air
in a supersonic stream is considered. Hypersonic
flight seemingly necessitates a ramjet engine using
this principle. Analytic approaches to the problem
developed in relation to the fluid-dynamic and chemi-
cal problems are reviewed. Three principal steps are
discussed concerning (1) the nature of the chemical
system in the absence of mixing or diffusion effects,
(2) the above-1-dimensional chemistry, combined with
mixing using a boundary layer type of analysis, and (3)
2-dimensional or axially symmetric combustion process-
es which take place within rigid boundaries and with
large pressure gradients.

780

General Dynamics/Astronautics, San Diego, Calif.

INFRARED TRANSMISSION THROUGH THE ATMOS-
PHERE, by A. E. S. Green and M. Griggs. [1963]
[10]p. incl. diagrs. tables. (AFOSR-64-0273) (AF 49-
(638)561) AD 432743   Unclassified

Also published in Appl. Opt., v. 2: 561-570, June 1963.

An analytic expression for transmission in terms of op-
tical path and pressure is combined with an analytical
expression for equivalent atmospheric path length in
terms of height and slant angle to yield a single ex-
pression for transmission in terms of height and slant
angle. Separate equations are developed for carbon
dioxide absorption, and for water vapor absorption.
The latter may be used with almost any water vapor
distribution in the atmosphere. A function due to
Chapman is used instead of the usual secant factor for
slant paths in order to extend the use of the equations
to angles of incidence up to 90°. Wavelength dependent
parameters are presented based upon Zachor's analytic
fits to laboratory data.

781

General Dynamics/Astronautics, San Diego, Calif.

HIGH-RESOLUTION STUDIES OF TYPE III SOLAR
EMISSION AT 11.4-METER WAVELENGTH, by W. C.
Erickson. [1963] [11p. (AF 49(638)561) AD 629343
                                        Unclassified

Also published in Jour. Geophys. Research, v. 68:
3169-3179, May 15, 1963.

Enhanced solar radio emission was observed during
May and June 1962 at a wavelength of 11.4 m (26.3
mc/s) by the Clark Lake antenna (a full description of
the antenna is in press). Two emission regions were
observed. They were of large angular size (about 2
to 3 solar radii in diameter), they fluctuated rapidly
in amplitude (periods about 4 sec or less), and they
appeared to rotate with the sun and to have been lo-
cated at distances of about 2.0 and 2.5 solar radii
from the sun's center. Correlation with sweptfrequen-
cy data indicates that most or all of the observed

emission was of spectral type III. On the basis of
these data plasma levels corresponding to densities of
8.5 x 1000000 electrons/cc are estimated to have been
at heights of 2.0 and 2.5 solar radii over the active re-
gions. These estimates agree well with the coronal
streamer model of Newkirk. The average brightness
distribution of one of the emission regions is found to
be consistent with the 'core and halo' model proposed
by Weiss and Sheridan.

782

General Dynamics/Astronautics, San Diego, Calif.

MAGNETIC FIELD DIFFUSION ASSOCIATED WITH AN
IONIZING SHOCK WAVE INTERACTING WITH AN
ELECTROMAGNETIC FIELD, by J. Rosciszewski and
A. Kritz. [1964] [2]p. incl. diagr. (AFOSR-65-2487)
(AF 49(638)1357) AD 629260   Unclassified

Also published in Phys. Fluids, v. 7: 1393-1394, Aug.
1964.

The diffusion of the magnetic field is calculated assum-
ing linearized flow behind the shock wave or arbitrary
strength.

783

General Dynamics Corp. General Atomic Div.,
San Diego, Calif.

CHEMICAL REACTIONS USING MODULATED FREE
RADICAL BEAMS, by W. L. Fite. Final rept. Oct. 1,
1962 - Sept. 30, 1963, Oct. 22, 1963, 29p. incl. diagrs.
refs. (Rept. no. GA-4682) (AFOSR-J1362) (AF 49-
(638)1191) AD 428699   Unclassified

Although the research was unable to make high quality
quantitative measurements on the $H + D_2 \rightarrow HD + D$ reac-
tion, the experience gained points important directions
for state-of-the-art improvements. Turning to the
$H + D_2$ case, it is clear that at least one of the follow-
ing technical advances must be made to ensure the suc-
cess of such measurements: (1) a D_2 purity higher than
99.5% must be obtained and if the signal-to-noise ratio
is to be increased by a factor of 10, the purity of the
D_2 should exceed 99.995%, since the HD impurity prob-
lem was one of noise; (2) better trapping than simple
condensation at a 4°K surface must be employed. The
present state-of-the-art is probably adequate to carry
out detailed studies of reaction collisions between hy-
drogen atoms and deuterated hydrocarbons using elec-
tron impace ionization.

784

General Dynamics Corp. General Atomic Div.,
San Diego, Calif.

SCATTERING OF ATOMIC BEAMS BY POLYCRYSTAL-
LINE NICKEL, by J. N. Smith, Jr. Nov. 5, 1963, 30p.
incl. diagrs. refs. (Rept. no. GA-4665) (AFOSR-
5439) (AF 49(638)1192) AD 429760   Unclassified

Also published in Jour. Chem. Phys., v. 40: 2520-2527, May 1, 1964.

The results of recent experimental studies of the scattering of beams of Kr, Ar, Ne, He and D_2 from polycrystalline nickel targets are presented and compared with the findings of other investigations of the phenomenology of heavy particle scattering at a solid surface. In the present experiments, as in certain earlier experiments utilizing alkali halide cleavage planes, large deviations from diffuse (cosine law) scattering are observed, which have not yet been satisfactorily interpreted. The present series of experiments tends to support a model for the scattering mechanism in which a fraction of the incident molecules are scattered diffusely and the remainder are scattered preferentially. From experimental observations, it is inferred that the slower particles in the incident beam contribute to the diffuse component while the faster particles are scattered preferentially. In addition, an angular variation in the degree of thermal accommodation of the incident particles is observed.

765

General Dynamics Corp. General Atomic Div., San Diego, Calif.

INTERACTIONS BETWEEN HYDROGEN AND OXYGEN ATOMS AND SURFACES, by J. N. Smith, Jr. Final rept. Oct. 1, 1962 - Oct. 31, 1964, 19p. incl. refs. (Rept. no. GA-5762) (AFOSR-64-2388) (AF 49(636)-1192) AD 608592   Unclassified

The ultimate goal of the research is to provide data concerning the transfer of energy and momentum between atoms and molecules and a solid surface in free molecule flow, and to investigate other processes that may occur in the gas-surface interaction. The program was conducted to provide the necessary boundary conditions to be used in the calculation of aerodynamic drag coefficients in rarefied gas flow. The modifications of the basic modulated atomic-beam machine used in the experiments are summarized. The general experimental method is discussed in some detail; however, experimental results are only outlined as the bulk of the work has been published previously; abstracts of these publications are included as appendices.

786

General Dynamics/Electronics, Rochester, N. Y.

HIGH-INTENSITY SOUND PROPAGATION, by D. T. Blackstock. Final rept. Nov. 1, 1961 - Sept. 30, 1963, 3p. (AFOSR-J1239) (AF 49(638)1118) AD 424311   Unclassified

A program of basic research on high-intensity sound is described. A number of problems, both theoretical and experimental, were studied. In general, the emphasis was on the effect which viscosity and heat conduction have on periodic, finite-amplitude (high-intensity) waves.

787

General Dynamics/Electronics, Rochester, N. Y.

THERMOVISCOUS ATTENUATION OF PLANE, PERIODIC, FINITE-AMPLITUDE SOUND WAVES, by D. T. Blackstock. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-64-1030) (AF 49(636)1118) AD 440984
          Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 534-542, Mar. 1964.

The propagation of a plane progressive wave of finite amplitude in a thermoviscous fluid is considered. The wave is taken to be purely sinusoidal in shape at its source. The approach is through Burgers equation, which is a very good approximation of the exact equations of fluid motion when effects of nonlinearity and dissipation are relatively small but definitely not negligible. A complicated but exact solution of Burgers' equation is analyzed. The nature of the solution is found to depend strongly on a parameter gamma, which represents the importance of nonlinearity relative to dissipation.

788

General Dynamics/Electronics, Rochester, N. Y.

APPROXIMATE EQUATIONS GOVERNING FINITE-AMPLITUDE SOUND IN THERMOVISCOUS FLUIDS, by D. T. Blackstock. May 1963, 47p. (Rept. no. GD1463 52) (AF 49(638)1118) AD 415442   Unclassified

The equations of motion for viscous, thermally conducting, inert fluids of arbitrary equation of state are approximated so as to account as simple as possible for effects of nonlinearity and dissipation. The purpose is to obtain a general improvement of the classical wave equation. The approximation method is basically the same as the one used by Lighthill (1956) to derive Burgers' equation for unbounded, progressive, plane waves in a perfect gas. Besides encompassing the case treated by Lighthill, the equations are applicable for nonplanar waves, for interacting waves, and for waves subject to boundary-layer effects. Moreover, the fluid need not be a perfect gas. Important simplifications arise when either boundary-layer or mainstream dissipation is negligible. When only mainstream losses are important, the assumption of plane progressive waves leads to Burgers' equation. Two forms of Burgers' equation are given. One is suitable for initial-value problems and the other is suitable for boundary-value problems.

789

General Dynamics/Electronics, Rochester, N. Y.

COMMUNICATION AND INFORMATION THEORY ASPECTS OF THE NERVOUS SYSTEM, by E. Agalides. Annual summary rept. Oct. 1, 1962 - Sept. 30, 1963, 57p. incl. illus. diagrs. tables, refs. (AFOSR-64-0825) (AF 49(638)1185) AD 437348   Unclassified

The contents of this report are: Multicoding-Unichannel and Multicoding-Multichannel Coding Theories of the Nervous System; Stimuli Transmission by the Giant Axon of Cambarus and Homarus Americanus; Neuron Simulators; Electromechanical Stimulator for Exerting Pressure on Skin Sensory Receptors; Piezoelectric Mechanical Transducer System and Terminology Used in Shannon's Theorem.

790

General Dynamics/Electronics, Rochester, N. Y.

THE EFFECT OF ACOUSTIC WAVES ON THE PACINIAN CORPUSCLE: A PRESSURE-SENSORY RECEPTOR OF THE SKIN, by E. Agalides. [1964] [18]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0294) (AF 49(638)1185) AD 611462   Unclassified

Also published in Trans. New York Acad. Sci., Ser. II, v. 26: 670-687, Apr. 1964.

Experiments were made which show that a mechanical stimulation of the pressure sensitive skin receptor, called the pacinian corpuscle, can be effected by acoustic waves. It was further possible to show that no coupling between the sensory receptor and the stimulator took place. The characteristics of the transmitting medium and of the transducers used are listed.

791

General Electric Co. Advanced Technology Lab., Schenectady, N. Y.

ON THE DISPERSED TWO-PHASE FLOW IN THE LAMINAR FLOW REGIME, by N. Zuber. Jan. 1963 [58]p. incl. diagrs. refs. (Rept. no. 63GL50) (AFOSR-4632) (AF 49(638)1153) AD 413515
                              Unclassified

Also published in Chem. Eng. Sci., v. 19: 897-917, 1964.

The time-dependent, dispersed, two-phase flow problem for the laminar flow regime is formulated. In agreement with Burgers' description of the flow, the analysis takes into account the effect of both the motion and the presence of other particles. The steady-state solution of the governing set of equations is applied to an analysis of sedimentation and of fluidization (batch, cocurrent and countercurrent). Good agreement with experimental data is shown. The steady-state results give a formulation and a confirmation of the basic premise in the theory of Elgin and Lapidus for vertical two-phase flow systems. The theory of kinematic waves proposed by Kynch and by Lighthill and Whitham is used to analyze the transient response, i.e., the diffusion process, and to predict the diffusivity in two-phase flow. The kinematic wave theory is used also to predict the operating limits imposed on the system by the flooding phenomenon.

792

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

RESEARCH ON THE INTERACTION OF GASES WITH NONMETALLIC SURFACES, by G. Ehrlich and B. McCarroll. Final rept. Feb. 1964, 7p. (Rept. no. 64GC0267M) (AFOSR-64-0475) (AF 49(638)791) AD 435174   Unclassified

Progress is reported on achieving a better understanding of the elementary atomic and molecular processes occurring when simple gases interact with a solid surface, with particular emphasis upon energy transfer in atomic collisions and the act of activation in dissociative adsorption. This report first takes up those investigations involving the ion microscope. This is followed by work on collision processes, depending mainly on theoretical analyses of the mechanics of these events, and by subsidiary studies of several related experimental effects.

793

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

TRAPPING AND ENERGY TRANSFER IN ATOMIC COLLISIONS WITH A CRYSTAL SURFACE. II. IMPURITIES, by B. McCarroll. [1963] [10]p. incl. diagrs. tables, refs. (AFOSR-64-0483) (AF 49(638)-791) AD 435182   Unclassified

Also published in Jour. Chem. Phys., v. 39: 1317-1326, Sept. 1, 1963.

The influence of surface impurities and internal impurities on (1) atomic condensation on a solid, (2) equilibration of the newly captured atom with the solid, and (3) the accommodation coefficient, are examined through calculations with a one-dimensional semi-infinite analog in the harmonic approximation. The general equation for the semi-infinite lattice (arbitrary composition) and impinging gas atom are specialized to a pure lattice with a surface impurity (variable mass and bonding), and a pure lattice with a defective third atom (variable mass and bonding). For the surface impurity: a decrease in coupling K decreases the condensation efficiency. Decreasing either the mass M or K decreases the rate of thermalization of a captured atom. There is a maximum in the condensation efficiency when M is varied. Light surface atoms do increase the accommodation coefficient. For the internal impurity: a weakening if impurity bonding decreases both trapping efficiency and rate of thermalization. Light impurities decrease the condensation efficiency, but increase the thermalization rate. The effect of the internal impurity on the accommodation coefficient is negligible.

794

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

CONDENSATION AND ENERGY TRANSFER ON

CRYSTALS, by B. McCarroll and G. Ehrlich. Mar. 20, 1963, 17p. (Rept. no. 63RL3291M) (AFOSR-64-0776) (AF 49(638)791) AD 435184 Unclassified

The collision of atoms with crystalline surfaces has an analogue in the semi-infinite linear chain of harmonically coupled particles struck on one end by an incident particle. Using this simple model, four different effects have been evaluated and compared with experiment: (1) the variation of the condensation efficiency with the mass of the impinging particle and with the strength of binding to the lattice; (2) the de-excitation of these atoms immediately after capture; (3) the efficiency of energy transfer to the lattice (accommodation coefficient) for collisions in which capture does not occur; and (4) the influence of defects on these quantities.

795

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

AN ATOMIC VIEW OF ADSORPTION, by G. Ehrlich. Feb. 1964, 28p. incl. illus. diagrs. tables, refs. (Rept. no. 64RL3575M) (AFOSR-64-0777) (AF 49-(638)791) AD 435185 Unclassified

Also published in Brit. Jour. Appl. Phys., v. 15: 349-364, 1964.

Modern experimental techniques, particularly flash desorption, field emission, and field ion microscopy, coupled with advances in ultrahigh vacuum technology, have made it possible to attain a detailed description of adsorption phenomena from routine measurements. Recent advances in the understanding of elementary atomic processes at the gas-solid interface, gained by these methods, are reviewed with particular emphasis on two topics: (1) the relation between surface structure and atom binding in physical adsorption as well as the chemisorption; (2) the kinetics of atomic condensation and equilibration.

796

General Electric Co. [General Electric Research Lab.] Schenectady, N. Y.

PREPARATION TECHNIQUES FOR GROWTH OF SINGLE CRYSTALS OF NONMETALLIC MATERIALS, by E. M. Clausen and J. W. Rutter. Final rept. June 1, 1963 - May 31, 1964. June 1964, 34p. (Rept. no. R64GC0279M) (AF 49(638)1247) AD 602945 Unclassified

The report describes two techniques for growth of high-purity single crystals of nonmetallic materials using r-f induction-heating equipment in a frequency range of 5 to 100 mc. One technique used for single-crystal growth was the Verneuil method using an induction-coupled plasma as a heat source instead of the conventional mixture of combustible gases. The second crystal growth technique investigated was floating-zone melting using r-f induction heating. The shape

of the freezing liquid-solid interface appeared to be an important factor in crystal growth by this technique.

797

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

GENERATION OF ORBITS BY GENERALIZED HILL CURVES, by V. G. Szebehely. [1963] [10]p. (AFOSR-J738) (AF 49(638)814) AD 414119 Unclassified

Also published in Jour. Franklin Inst., v. 275: 371-380, May 5, 1963.

Two-degrees-of-freedon dynamical systems are investigated by extending the application of zero velocity or Hill curves. A general set of dynamical problems including the restricted problem of three bodies—is established, and it is shown that the presented system possess zero velocity curves. The general problem of using the Hill curves for orbit generation is solved, and several examples are given.

798

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

ON ISOTACH ORBITS, by V. Szebehely. [1963] [14]p. (AFOSR-J1026) (AF 49(638)814) AD 419736 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 13: 192-205, 1963.

Investigations of special cases of the restricted problem of three bodies utilize the family of zero velocity curves, often referred to as Hill curves. It is known that certain regions of possible motion can be established by means of these curves, that orbits might exhibit cusps at the Hill curves, that some numerically obtained periodic orbits show "similarity" to the Hill curves, etc. The general relation between the zero velocity curves and orbits for certain classes of dynamical problems (including the restricted problem) is investigated and conditions which give precise analytical meaning to the above mentioned similarity are established.

799

General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

APPLICATION OF THE RESTRICTED PROBLEM OF THREE BODIES TO SPACE MECHANICS, by V. Szebehely. [1963] [31]p. (AFOSR-J1290) (AF 49-(638)814) AD 424210 Unclassified

Also published in Space Sci. Rev., v. 2: 219-249, 1963.

The most celebrated problem of dynamics, the problem

of three bodies, is defined in the first chapter and it is shown how the probleme restreint is obtained from the general formulation. This is followed by a historical review of the restricted problem from the point of view of space dynamics applications and the present state of the art is described in some detail. The third and final chapter reviews the major activities in the field of space mechanics and their relation to the restricted problem are pointed out. The purpose of this compte rendu is to demonstrate two theses. Firstly, based on the history of the restricted problem of three bodies, it will be shown that combining recent advances in computer technology and in analytical dynamics with modern topological techniques, a terr firma exists for a new attack on this classical problem. The second thesis is that the restricted problem of three bodies plays a central role in celestial mechanics and in space dynamics.

800

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

ON THE STABILITY OF THE EQUILIBRIUM SOLUTIONS OF THE PLANE RESTRICTED THREE BODY PROBLEM IN THE SENSE OF LIAPOUNOV, by S. E. Moskowitz. Final rept. Apr. 1964, 28p. (Rept. no. R64SD34) (AFOSR-64-0361) (AF 49(638)814) AD 438857   Unclassified

The stability of the five equilibrium solutions of the plane restricted three body problems is investigated in a topological sense of Liapounov. This aspect of motion has always been a subject of considerable interest primarily because the stability criteria were derived from linearizing the dynamical equations. It is shown that the question cannot be resolved by means of existing theorems governing the first approximation since these cases belong to an exceptional class which Liapounov had termed critical. The stability of the equidistant positions and instability of the collinear solutions are established however in accordance with a less restrictive definition by using surfaces which are formed from the Jacobi integral.

801

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

MAGNETOHYDRODYNAMIC PROPULSION, by A. Sherman. Jan. 1963, 27p. incl. diagrs. refs. (Rept. no. R63SD5) (AFOSR-4636) (AF 49(638)914) AD 295721   Unclassified

Within the present report the entire area of magnetohydrodynamic propulsion is reviewed. To begin with continuous flow plasma accelerators are discussed, and the current status of theoretical and experimental studies presented. Both the normal crossed field devices and the so-called Hall accelerators are described. It is shown that these devices offer the promise of efficient operation in the 2-4000 sec specific impulse range. Next the pulsed plasma accelerator with electrodes is considered. Experimen-

tal results with confined rail type devices are shown to yield high efficiencies for specific impulses greater than 5000 seconds for times of operation on the order of days. Similar results at lower specific impulses are not yet available. Finally, the experimental work on the pulsed electrodeless device is described, and it is shown that as yet relatively low efficiencies have been obtained. Some of the causes of such low efficiencies are discussed. The extension of this concept to the traveling wave machine is also included. (Contractor's abstract)

802

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

MAGNETOHYDRODYNAMIC BOUNDARY LAYERS, by A. Sherman. Jan. 1963, 34p. incl. diagrs. (Rept. no. R63SD4) (AFOSR-4637) (AF 49(638)914) AD 294720   Unclassified

A review of those new phenomena which arise in magnetohydrodynamic boundary layers is presented in this report. The first topic discussed due to its simplicity and relation to boundary layer flows is the Rayleigh problem. Here it is shown that the introduction of magnetohydrodynamic forces leads to basic changes in the nature of the flow. Next the basic boundary layer equations are deduced and the conditions necessary to yield similar solutions deduced. In succeeding sections incompressible and compressible boundary layers are treated with attention paid to the appropriate external boundary conditions. Finally, boundary layer phenomena arising when $R_m \to \infty$ are considered in order to illustrate some new phenomena within the framework of boundary layer theory. (Contractor's abstract)

803

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

FUNDAMENTALS OF MHD FLOW, by A. Sherman. Final rept. June 1964, 12p. incl. refs. (AFOSR-64-1425) (AF 49(638)914) AD 617562   Unclassified

Magnetohydrodynamic phenomena associated with crossed field devices are investigated. The working medium was assumed to be a partially ionized plasma at relatively low temperatures (1500-3000°K), so that magnetic Reynolds numbers were assumed to be much less than one. As a result, it was typically assumed that the applied magnetic field was not distorted by currents flowing in the plasma, although for some problems this simplification was not necessary. Several studies were made of the properties of the low temperature plasmas of interest. Then a large number of channel flow problems were analyzed and reported upon. Some magnetohydrodynamic boundary layer phenomena were next reviewed, and following this a broad review was made of the propulsion and power generation application areas. New concepts were developed for the macroscopic description of the non-equilibrium ionization idea.

804

General Electric Co. Space Sciences Lab.,
Philadelphia, Pa.

LINEARIZED ANALYSIS OF MHD FLOW STABILITY,
by G. W. Sutton and E. Witalis. Jan. 1964, 11p.
(Rept. no. R64SD5) (AF 49(638)914) AD 429173
Unclassified

The quasi one-dimensional compressible flow equations
for a magnetohydrodynamic power generator were
analyzed for one-dimensional instabilities by means of
linearized perturbations. The gas was assumed to be
ideally compressible, inviscid, nonheat-conducting,
with an electrical conductivity that depends on local
temperature. The results indicate that large insta-
bilities cannot exist, confirming the previous approxi-
mate results of Wright and refuting the original claims
of Velikhov.

805

General Electric Co. Space Sciences Lab.,
Philadelphia, Pa.

NON-EQUILIBRIUM IONIZATION AND MAGNETOHY-
DRODYNAMIC PHENOMENA, by A. Sherman. Doc-
toral thesis, May 1964, 126p. (Rept. no. R64SD36)
(AF 49(638)914) AD 600526   Unclassified

The present report deals with the interaction between
non-equilibrium ionization phenomena in a plasma and
the non-uniform flow of that plasma. The phenomenon
of non-equilibrium ionization is first analyzed for a
stationary plasma in the presence of an electric field.
It is then shown that similar phenomena will exist in a
moving plasma in the presence of a magnetic field.
Based on these concepts the appropriate species equa-
tions are derived and combined to yield a single fluid
theory of the phenomena in question. By this device it
is shown that in general the electrical conductivity may
be expressed as a function of the current density. Us-
ing this idea and assuming simple functional depen-
dencies the Hartmann flow is solved despite the non-
linearity of the problem. Numerical solutions are
also obtained when the Hall effect is present. Based
on these calculations certain unexpected limitations
on the physical parameters of the problem appear.

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General Electric Co. Space Sciences Lab.,
Philadelphia, Pa.

STRUCTURAL RESPONSE TO INTENSE ELECTRO-
MAGNETIC RADIATION, by R. C. Good, Jr. Second
annual technical rept. Mar. 1, 1962 - Feb. 28, 1963,
80p. incl. illus. diagrs. tables, refs. (AFOSR-5096)
(AF 49(638)1030) AD 413974   Unclassified

An exploding wire apparatus has been used to study
conversion of electrical energy into strain energy in
glass samples that have been either irradiated by the
electromagnetic waves emitted by the wire or en-
veloped by plasma formed by the wire. The strain

energy left permanent marks on the sample as dis-
coloration, weight loss, and surface cracks. These
were used to confirm the theoretical analysis as to
method and to dimensions. Conversion of energy with-
in the sample was postulated to involve thermal ab-
sorption, diffusion, and strain. The thermal diffusion
equation was solved and values computed for the heat-
ing and cooling portions of the pulse. By linking the
quantity of material heated with experimental meas-
urements, an overall absorption coefficient for glass
of 10^3 cm and an energy deposition of 1/2 joule/sq cm
was found.

807

General Electric Co. Space Sciences Lab.,
Philadelphia, Pa.

DIRECT MEASUREMENT OF VELOCITY DISTRIBU-
TION FUNCTIONS, by E. P. Muntz. Aug. 1964, 62p.
incl. diagrs. tables, refs. (Rept. no. R64SD59)
(AFOSR-64-1599) (AF 49(638)1152) AD 604252;
AD 608545   Unclassified

Also published in Rarefied Gas Dynamics; Proc.
Fourth Internat'l. Symposium, Toronto U. (Canada)
(July 14-17, 1964), ed. by J. H. de Leeuw. New York,
Academic Press, v. 2: 128-150, 1966.

A method for measuring velocity distribution functions
in rarefied gas flows was investigated. The technique
is a direct determination, accurate to within one per-
cent, which does not significantly disturb the flow un-
der investigation. It is shown that accurate measure-
ments can be made of the Doppler profile of emission
lines excited by an electron beam. The method depends
upon the tendency of high energy electrons to transfer
relatively little momentum to the nuclei when they ex-
cite the electronic levels of gas molecules. The tech-
nique presented could be used in the study of normal
shock waves and other investigations in rarefied gas
dynamics research.

808

General Electric Co. Space Sciences Lab.,
Philadelphia, Pa.

A FEASIBILITY STUDY OF THE MEASUREMENT OF
ION DENSITIES BEHIND AIR SHOCKS BY INTRODUC-
ING SMALL AMOUNTS OF LITHIUM VAPOR, by B.
Cary and W. Nickels. Sept. 1963, 50p. (Rept. no.
R63SD82) (AF 49(638)1157) AD 423565
Unclassified

Preliminary experiments indicated that ionization equi-
librium is attained in the shock tube behind strong
shocks in argon and that the boundary layer appears
to electrically insulate the gas from the metal tube
walls. The anomalous method was used to measure
the amounts of lithium vapor injected into the shock
heated air and it is concluded that concentrations of
300 ppm could be maintained within a factor or two.
Experimental data is presented which suggest that the
presence of the lithium vapor has no great effect upon
either the vibrational relaxation rate of nitrogen or

the overall dissociation rate of oxygen. Interferometric
evidence indicated that the bulk dissociation processes
did equilibrate behind M 18 shock waves in air al-
though Stark measurements by the 4603A lithium line
suggest that ionic equilibrium is not attained.

809

General Electric Co. Space Sciences Lab.,
Philadelphia, Pa.

RESEARCH ON HYPERSONIC RAREFIED PLASMA
FLOWS, by S. M. Scala. Final rept. Oct. 15, 1963 -
Oct. 14, 1964. Nov. 13, 1964, 32p. (AFOSR-64-
2471) (AF 49(638)1283) AD 609496   Unclassified

A modified form of the Chapman and Enskog transport
theory for gas mixtures was developed for a neutral,
binary mixture with disparate molecular weights. The
difficulties in the past have been that the usual Chapman
and Enskog theory was based on a single time scale
for the molecular relaxation. As pointed out by Grad,
this relaxation occurs on a multiple time scale, and
this fact is exploited in deriving a modified Chapman
and Enskog theory.

810

General Mills, Inc., Minneapolis, Minn.

ELECTRICAL CHARACTERISTICS OF GRAIN BOUND-
ARIES IN COMPOUND SEMICONDUCTORS, by R. K.
Mueller. Final rept. June 28, 1963 [20]p. incl. diagrs.
refs. (Rept. no. 2404) (AFOSR-64-1092) (AF 49(638)-
628) AD 600321   Unclassified

The principal effort was directed toward the prepara-
tion of low-angle grain boundaries in indium antimo-
nide (InSb) and the study of their electrical and gal-
vanomagnetic properties with the ultimate objective of
relating these properties to the structure of the
boundary.

811

General Mills, Inc., Minneapolis, Minn.

PHOTOCONTROLLED SURFACE CONDUCTANCE IN
ANODIZED InSb, by R. K. Mueller and R. L. Jacobson.
[1964] [6]p. (AFOSR-64-1744) (AF 49(638)628)
AD 448291   Unclassified

Also published in Jour. Appl. Phys., v. 35: 1524-1529,
May 1964.

Anodized p-type InSb, cooled to the extrinsic conduc-
tion range in the dark, was found to have an n-type in-
version layer at the surface. Illumination changes the
n-type inversion layer to a p+ accumulation layer; any
intermediate surface condition can be obtained by con-
trolled exposure. A method for determining the sur-
face conductance of the inversion layer is described.
This method utilizes high impedance grain boundary
barrier to avoid shunting of surface conduction by bulk
conduction. The highest surface conductance on

unilluminated anodized samples was found to 100
umhos/square. Spectral response measurements show
that photons in the energy range 0.8 to 3.5 ev are ef-
fective. The effect is believed due to photoemission of
electrons from the InSb into the oxide. Transient re-
sponse measurements for light on and off conditions on
n- and p-surfaces support this model.

812

General Mills, Inc., Minneapolis, Minn.

InSb DIODES UNDER CONTROLLED SURFACE CONDI-
TIONS, by K. N. Maffitt and R. K. Mueller. [1964]
[2]p. (AFOSR-64-1745) (AF 49(638)628) AD 448292
    Unclassified

Also published in Jour. Appl. Phys., v. 35: 1563-
1564, May 1964.

The surface of anodized InSb cooled in the dark can be
changed from n type over a conductance minimum to p
type by controlled illumination. The characteristics
of alloyed diodes on n- and p-type base material were
studied at 78°K under controlled surface conditions.
Under optimal surface conditions the voltage-current
characteristic follows the relation predicted by Sah
et al, for space-charge generation currents. An ef-
fective minority carrier lifetime of 2.4×10^{-9} for n-
type and 2.8×10^{-9} for p-type InSb is required to fit
the data. An anomalous capacitance is observed only
if an inversion layer exists at the surface.

813

General Motors Corp. Allison Div., Indianapolis, Ind.

RAIL TYPE PULSED PLASMA ACCELERATION, by
T. L. Rosebrock, D. L. Clingman, and D. G. Gubbins.
Final rept. Apr. 1963, 123p. (Rept. no. EDR3255)
(AFOSR-5070) (AF 49(638)864) AD 467202
    Unclassified

Descriptive equations for the acceleration process are
derived, including effects of nonparallel electrodes;
analog solutions for the equations are presented. The
plasma mass-velocity distribution is discussed. Ana-
lytical treatments are presented for the generalized
magnetic field, copper gas ionization and conductivity,
energy efficiency, system energy distribution, plasma-
electrode interaction, supplementary magnetic fields,
and alkali salt propellants. Specific items of instru-
mentation are described. Experimental studies for
both fast and slow circuits are discussed in which elec-
trode geometries, propellant materials, propellant
mass, plasma dispersion, pressure effects, external
magnetic fields, electrode conditioning, electrode ma-
terials, electrode erosion, and propellant geometry
are considered. Vapor-deposited film propellants are
found to provide a basis for considerable optimism in
regard to the future of pulsed plasma accelerators.

814

General Precision, Inc. [Librascope Group] Glendale, Calif.

RESEARCH ON THE ANALOGICAL SIMULATION OF NEURAL BEHAVIOR. Final rept. Mar. 1961 - Mar. 1963, 25p. (AFOSR-4952) (AF 49(638)1021)
AD 414014   Unclassified

This report summarizes research focused on three major problem areas: (1) Nerve network theory; (2) Electronic models of the neuron; (3) Gas ion models of the neuron. The general objective of this research has been to advance knowledge of the information processing capabilities of neural systems.

815

General Precision, Inc. [Librascope Group, Glendale, Calif.]

NEURAL THEORY AND MODELING; PROCEEDINGS OF THE 1962 QJAI SYMPOSIUM, Ojai, Calif., Dec. 4-6, 1962, ed. by R. F. Reiss. Stanford U. Press, 1964, 427p. incl. illus. diagrs. refs. (AFOSR-64-1694) (AF 49(638)1232)   Unclassified

This book, comprising twenty-one papers read at the symposium, presents various approaches to general and specific problems of the single neuron and of small, intermediate and large neural systems. Analytic techniques range from elementary quantitative and logical models to differential and field equations, including "black-box" models of sensory-motor systems, digital-computer simulation programs, and electronic and gas-ion analogs. The first group of papers deals with broad theoretical problems and general modeling techniques. The second group of papers presents data, theories, and models of particular neural systems. Systems analyzed are primarily those of the invertebrates. Such systems lend themselves readily to analysis, since they are simple and experimentally accessible compared with the vertebrate control nervous systems heretofore more widely used in modeling studies.

816

General Precision, Inc. Aerospace Research Center, Little Falls, N. J.

RESEARCH IN THE RESTRICTED PROBLEMS OF THREE AND FOUR BODIES, by P. B. Richards, I. S. Bernstein and others. Final technical rept. Nov. 1964, 4p. incl. diagr. (AFOSR-64-2492) (AF 49(638)1325)
AD 609613   Unclassified

Leontovic has established the stability of the triangular critical points of the planar restricted three-body problem. This theory can now be applied to the restricted problems of three and four bodies in the investigation of stability properties of known periodic motions. Two separate studies have been conducted in the restricted four-body problem. One dealt with the determination of particular solutions of the linearized equations of

motion in the neighborhood of the L_1 libration point of the restricted three-body problem. The second part of the restricted four-body study has been concerned with the existence of periodic trajectories of the nonlinear equations of motion. The Poincare method of small parameters was successfully used to establish the existence of periodic trajectories in the neighborhoods of the libration points.

817

General Precision, Inc. Aerospace Research Center, Little Falls, N. J.

SOME PERIODIC SOLUTIONS OF A FOUR-BODY PROBLEM, by J. Cronin, P. B. Richards, and L. H. Russell. [1964] [6]p. incl. diagr. (AFOSR-65-0617) (AF 49(638)1325) AD 614295   Unclassified

Also published in ICARUS, v. 3: 423-428, Dec. 1964.

A four-body problem which is a model for the motion of a particle or vehicle in the Sun-Earth-Moon system is obtained by rotating the barycenter B of the two massive bodies in a restricted three-body configuration about a third massive body. It is shown that this problem can be regarded as a perturbation of the restricted three-body problem where the perturbation parameter is the mass of the third body divided by the cubed distance from the third body to B. It is proved that under certain conditions, especially with a restriction on the magnitude of the perturbation parameter, the particle of negligible mass has a periodic motion near each of the libration points of the restricted three-body problem; a method for estimating the restriction on the magnitude of the perturbation parameter is described.

818

Geneva U. (Switzerland).

A BIBLIOGRAPHY ON FUNCTIONAL EQUATIONS, by G. I. Targonski. Annual summary rept. no. 1, Apr. 30, 1963, 74p. incl. refs. (AFOSR-4973) (AF 61(052)-602) AD 414115   Unclassified

This is a bibliography on the literature of functional equations, up to approximately the middle of 1962. In order to compile such a bibliography, it was necessary first to define a Functional Equation. This has been done in the past several ways, some of which appear too wide, others too narrow. In the most general case, a Functional Equation is an equation which serves to determine one, or more unknown functions, or classes of such functions. In this sense, every differential, -difference, and integral equation is also a Functional Equation; to compile a bibliography on such a wide class is almost certainly impossible and most certainly unnecessary.

819

Genoa U. [Neurosurgical Clinic] (Italy).

SLEEP INDUCING MECHANISMS IN THE BRAIN STEM,

by G. F. Rossi. [1963] [20]p. (AFOSR-J1421)
(AF 61(052)461) AD 427581   Unclassified

Also published in Electroencephalog. and Clin Neuro-
physiol. Jour., Suppl. 24: 113-132, 1963.

A sleep inducing influence in the brain stem, has its
origin in structures located in the caudal part of the
brain stem, mainly in the medulla oblongata and in the
pons. Some findings suggest that neural processes un-
derlying the light phase of sleep take place in the ros-
tral medulla and caudal pons, while those responsible
for deep sleep occur in the rostral half of the pons.
The sleep inducing structures, or at least those re-
sponsible for deep sleep, appear to belong to the retic-
ular formation. Reticular neurones having sleep in-
ducing function and reticular neurones of the activating
system seem intermingled at the same level of the
brain stem. A continuous, tonic activity is probably
going on in both types of neurones. Sleep and wakeful-
ness would result from competition between them.

830

Genoa U. [Neurosurgical Clinic] (Italy).

VISUAL CORTICAL RESPONSES EVOKED BY STIMU-
LATED LATERAL GENICULATE BODY AND OPTIC
RADIATIONS IN AWAKE AND SLEEPING CATS, by
M. Palestini, M. Pisano, and others. [1964] [14]p.
(AFOSR-64-1196) (AF EOAR-62-106) AD 442838
                                        Unclassified

Also published in Exper. Neurol., v. 9: 17-30, 1964.

Electrical potentials were evoked in the visual cortical
area of intact unanesthetized cats by single-shock
stimulation of the lateral geniculate body and optic
irradiations. Several (50-200) cortical responses were
recorded during each one of the three following be-
havioral conditions: light sleep (electroencephalograph-
ic synchronization); deep or activated sleep (electro-
encephalographic desynchronization); and wakefulness.
The relations between amplitude of the fourth and fifth
components of the evoked potentials and state of alert-
ness were studied. The mean amplitude of the corti-
cal responses to thalamic stimulation is maximum dur-
ing activated sleep and minimum during light sleep.
The degree of thalamic and of cortical excitability dur-
ing light sleep seems to be different.

821

Genoa U. Neurosurgical Clinic (Italy).

A HYPOTHESIS ON THE NEURAL BASIS OF CON-
SCIOUSNESS, by G. F. Rossi. [1964] [11]p. incl.
diagrs. (AFOSR-64-2267) (AF EOAR-62-106)
AD 452385   Unclassified

Also published in Acta Neurochirurg., v. 12: 187-197,
1964.

The following hypothesis concerning the neural events
responsible for the changes of consciousness is formu-
lated: the regulation of the level of consciousness under

physiological conditions is achieved by the interplay of
two opposite competing mechanisms: a facilitating or
arousing mechanism and an inhibitory or sleep inducing
one; the most important neural structures involved be-
long to the brain stem. The experimental findings on
which the hypothesis is based are reported and dis-
cussed; particular emphasis is placed on studies show-
ing that the decrease of the level of consciousness (or
sleep) may occur via an active mechanism. The pos-
sible clinical implications of the hypothesis are
mentioned.

822

Genoa U. [Neurosurgical Clinic] (Italy).

[EFFECT OF UNILATERAL SELECTIVE LESIONS ON
"SPECIFIC" AND "NON-SPECIFIC" STRUCTURES IN
THE PONS ON EEG ACTIVITY DURING DEEP SLEEP]
Effetti di lesioni unilaterali selettive di strutture
"specifiche" ed "aspecifiche" del ponte sull'attivita'
elettroencefalografica del sonno profondo, by O.
Candia and K. Minobe. [1963] [3]p. (AFOSR-64-0952)
(AF EOAR-64-11) AD 439985   Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 39:
1566-1568, 1963.

The study shows that the fast low voltage activity of
deep phase of sleep in the cat is altered by a cut through
the pons, and is not due to a lesion in a specific spot
in the pons but to the whole rostral part.

823

Genoa U. Neurosurgical Clinic (Italy).

[STUDY OF CORTICAL EXCITABILITY DURING SLEEP
AND WAKEFULNESS: CYCLE OF EXCITABILITY OF
THE VISUAL CORTEX OF THE CAT] Studio dell'ec-
citabilita' corticale durante il sonno e la veglia: ciclo
di eccitabilita' della corteccia visiva nel gatto, by M.
Palestini, M. Pisano and others. [1963] [3]p.
(AFOSR-64-1856) (AF EOAR-64-11) AD 450100
                                        Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 39:
1662-1664, 1963.

Evoked potentials on the EEG were caused by a pair of
electric shocks delivered to cats during sleeping and
waking. Results indicate that visual cortex is more ex-
citable in sleep than in wakefulness.

824

Genoa U. Neurosurgical Clinic (Italy).

NEUROPHYSIOLOGIC MECHANISMS OF SLEEP, by
G. F. Rossi. Final rept. Oct. 1963 - Sept. 1964.
Sept. 30, 1964, 8p. incl. refs. (AFOSR-64-2063)
(AF EOAR-64-11) AD 452299   Unclassified

The report summarizes the results obtained on the ex-
perimental study of the neurophysiology of sleep and

arousal. Most of the experiments were devoted to the study of the anatomical identification of the brain stem sleep inducing structures. Other experiments have been performed to investigate on the excitability of the cerebral cortex during sleep by electrical stimulation of the cerebral cortex.

825

Georgetown U. Dept. of Physics, Washington, D. C.

VIBRATIONAL ENERGY LEVELS OF IONIC MOLE-
CULES BOUND BY CLASSICAL FORCES, by E. J.
Finn. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-
64-0262) (AF AFOSR-62-160) AD 432528
Unclassified

Also published in Jour. Chem. Phys., v. 39: 2423-
2428, Nov. 15, 1963.

Theoretical vibrational energy levels of LiI, NaCl, and
InF are computed by means of the first-order WKB
approximation. Two classical vibrational potentials
are studied for each molecule. The first consists of
a Coulombic attraction and an exponential repulsion
term, while the second potential adds a polarizability
term to the first. Analysis of the data shows that at
very low v a power series $(v + 1/2)$ adequately repre-
sents the energy levels, while at very high v the en-
ergy levels approach those of a hydrogenlike atom.
Further, the first energy difference curves show posi-
tive curvature at all v for all cases. Formulas are
presented that accurately yield the vibrational energies
at all v. (Contractor's abstract)

826

Georgetown U. [Dept. of Physics] Washington, D. C.

ON THE USE OF THE WBK METHOD FOR OBTAIN-
ING ENERGY EIGENVALUES, by C. L. Beckel, J.
Nakhleh, and Y. R. Chowdary. [1964] [7]p. (AFOSR-
64-1045) (AF AFOSR-62-160) AD 441498
Unclassified

Also published in Jour. Chem. Phys., v. 40: 139-145,
Jan. 1, 1964.

A general method is proposed for evaluation of the
second-order WBK energy integral. The domain of
the potential is extended into the complex plane by ex-
pansion in Taylor's series about the classical turning
points. The method is illustrated by application to the
one-dimensional harmonic oscillator for which the
second-order integral is exactly zero. Application is
also made to a typical molecular potential, the Heitler-
London potential for hydrogen. In the latter problem
'exact' eigenenergies, accurate to about 0.2 cm, are
obtained by a Runge-Kutta integration of the Schro-
dinger equation. These are compared with first-order
WBK energies obtained with and without use of the
Langer-Kemble radical correction, and with second-
order WBK energies obtained with and without use of
the Langer-Kemble correction.

827

Georgia Inst. of Tech. School of Chemistry, Atlanta.

MECHANISMS OF NUCLEOPHILIC SUBSTITUTION IN
PHOSPHATE ESTERS, by J. R. Cox, Jr. and O. B.
Ramsay. [1964] [36]p. incl. diagrs. tables, refs.
(AFOSR-66-1617) (AF AFOSR-62-163) AD 640173
Unclassified

Also published in Chem. Rev., v. 64: 317-352, July
24, 1964.

This report reviews the literature through Dec. 1963
concerning mechanisms of nucleophilic substitution in
phosphorus-(V) esters. Emphasis is placed on cata-
lytic processes which may serve as models for cataly-
sis by biological systems such as enzymes.

828

Georgia U. Bioelectronic Computer Lab., Athens.

DIGITAL RECORDING AND ANALYSIS OF PSYCHO-
PHYSIOLOGIC EXPERIMENTS, by H. Zimmer. [1964]
[20]p. incl. tables, refs. (AFOSR-65-0578)
(AF AFOSR-63-257)   Unclassified

Also published in Data Acquisition and Processing in
Biology and Medicine, ed. by K. Enslein, New York,
Pergamon Press, 1964.

A data collection system for the recording of autonom-
ic nervous system variables was constructed in order
to facilitate data reduction for a number of experiments
in which autonomic nervous system reactions are of in-
terest as the dependent variables. This system is em-
ployed in experiments on pain perception, feedback of
emotional reactions, the subject's facilitation or in-
hibition of his autonomic reactions by self-initiated sig-
nals, and the conditioning of autonomic nervous sys-
tem reactions to critical symbols and their generaliza-
tion to related symbols. It has now become apparent
that the data reduction speed provided by this system
opens up entirely new fields of experimentation.

829

Georgia U. [Dept. of Chemistry] Athens.

A THERMODYNAMIC STABILITY SCALE FOR STABLE,
ISOLABLE FREE RADICALS, by R. C. Lamb and
C. T. Clark. Final technical rept. Oct. 1, 1961 -
Sept. 30, 1963. Nov. 1963, 28p. (AFOSR-J1520)
(AF AFOSR-62-53) AD 429279   Unclassified

During the report period, seven galvinoxyl derivatives
were placed on an approximate stability scale based on
their affinities for the H atom furnished by diphenyl-
picrylhydrazine (in benzene), although the stability
scale is not very accurate, it appears to be essentially
correct. The thermodynamic groundwork on which the
scale is based allows the ΔF values to be cross-
checked. Four experiments on the galvinoxyl-di-
phenylpicrylhydrazine system were also performed in
90% tert. butyl alcohol-10% benzene. The value

obtained for ΔF is +0.97 = 0.02 kcal at 30°. Free radical scavenger experiments with Koelsch's radical are reported.

830

Georgia U. Dept. of Chemistry, Athens.

CHEMICAL AND ENZYMATIC STUDIES ON THE CON-VERSION OF CHEMICAL ENERGY TO LIGHT, by G. E. Philbrook. Final technical rept. June 1964 [24]p. incl. diagrs. (AFOSR-64-1271) (AF AFOSR-62-73 and AF AFOSR-63-44) AD 602798
Unclassified

The work covered involved chemical and enzymatic studies on the conversion of chemical energy to light. The initial studies were devoted to studying the meth-ods for the preparation and purification of luminol and its analogs. The second category of work involved the discovery of the chemiluminescence of indole and certain of its derivatives. Extensive studies were made of the relationship between the conditions of the reactions and the intensity of the light emission and to a study of the chemical nature of the chemilumines-cent reaction. The third group of studies was devoted to the attempted preparation of cinnolines with the ob-ject of determining whether or not these compounds were chemiluminescent. The fourth category involved studies of the action of chlorine dioxide as an oxidiz-ing agent. The fifth category involved the study of the chemiluminescence of iophine and its derivatives.

831

Georgia U. Dept. of Chemistry, Athens.

CHEMILUMINESCENT INTENSITIES FROM SUBSTI-TUTED LOPHINES, by G. E. Philbrook and M. A. Maxwell. [1964] [6]p. incl. diagr. (AFOSR-64-1850) (AF AFOSR-63-44) AD 449979   Unclassified

Also published in Tetrahedron Ltrs., v. 19: 1111-1116, 1964.

A series of 14 compounds, derivatives of lophine bear-ing substituent groups in the 3 and/or 4 positions of the 2-phenyl group were prepared. All gave satisfactory elemental analyses and satisfactory IR and UV absorp-tion spectra, as well as satisfactory chemiluminescence data. The intensities were determined using a 1P21 photo tube coupled to a sensitive amplifier and a pen recorder. The chemiluminescent intensities were de-termined in a medium consisting of 70% dimethyl-sulfoxide-30% water, 1 N. in NaOH. The concentra-tion of iophine derivatives was 1.5 x 10^{-3} M. Oxygen was bubbled through the solutions continuously. The intensity rose to a maximum in 1-2 min and then fell over a 10-20 min period to a nearly constant value lasting from 2-12 hrs, depending on the compound.

832

Georgia U. Dept. of Chemistry, Athens.

ORGANIC PEROXIDES. III. THE BEHAVIOR OF CYCLOHEXANEFORMYL PEROXIDE IN THE PRES-ENCE OF EXCESS STABLE RADICALS. THE SIMUL-TANEOUS DETERMINATION OF KINETICS AND FREE RADICAL EFFICIENCIES IN THE THERMAL DECOM-POSITIONS OF FREE RADICAL INITIATORS, by R. C. Lamb and J. G. Pacifici. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-64-1534) (AF AFOSR-64-543) AD 446136   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 914-918, Mar. 5, 1964.

The first-order rate constants and free radical effi-ciencies in the thermal decompositions of cyclohexane-formyl peroxide in benzene in the temperature range 30°-50°C were determined spectrophotometically by measuring the fading of galvinoxyl, which was present in excess. Experiments in which α, γ-bis-(diphenyl-ene)-β-phenylallyl (BDPA) and DPPH were used as scavengers in benzene at 45°C gave results similar to those obtained in the galvinoxyl experiments. All of the experiments indicate a low free radical efficiency (24% or less) for the decomposition of cyclohexane-formyl peroxide in benzene. The volatile products formed in the decomposition of cyclohexaneformyl peroxide in benzene containing excess galvinoxyl are ester, acid, bicyclohexyl, cyclohexane, and cyclohex-ene. (Contractor's abstract)

833

Geotechnical Corp., Garland, Tex.

OPERATIONAL MAGNIFICATION AND PHYSICAL EN-VIRONMENT OF SEISMOGRAPH STATIONS, by S. A. Alsup and J. W. Guyton. [1964] [10]p. (AF 49(638)-1150) AD 439247   Unclassified

Also published in Geophysics, v. 29: 188-196, Apr. 1964.

Maximum satisfactory operational magnifications of 115 standardized seismograph stations in the United States range from 30,000 to 630,000 and are used to evaluate the sites relative to one another. Grouping the sites according to physiographic province, rock type, distance from cultural features, and type of installation shows distinct correlation between physi-cal environment and operating magnification. Regional variations of magnification capability are closely re-lated to physiographic provinces; local variation with-in a province is as great as the variation of physical environment.

834

Geotechnical Corp., Garland, Tex.

STUDY OF SHORT-PERIOD SEISMIC NOISE, by J. W.

Guyton. Semiannual technical summary rept. no. 3, July 31 - Dec. 31, 1963, 1v. (Technical rept. no. 64-1) (AF 49(638)1150) AD 431768   Unclassified

The contents of this report are: Systematic deviations of magnitude from body waves at seismograph stations in the United States; Average signal-to-noise ratios for 26 seismograph stations in the United States; Data processing facility; Shallow refraction study of seismometer installations; and Effectiveness of air-to-ground coupling for acoustic waves at the Wichita Mountain Seismological Observatory.

835

Giannini Controls Corp. [Astromechanics Research Div.] Malvern, Pa.

THE EFFECT OF ELASTICITY ON THE STABILITY OF MANNED ROTATING SPACE STATIONS, by F. J. Frueh and J. M. Miller. May 1964, 28p. (Rept. no. TR-02-004) (AFOSR-64-0991) (AF 49(638)1015) AD 602486   Unclassified

A basic investigation of the effects of structural flexibility of the rotating space station concept in terms of system stability is presented. The results of the analyses were formed into general stability criteria using the fundamental characteristics of the space station system. The criteria show the relationship between applied forces, configuration flexibility and configuration damping and are presented in a manner suitable for preliminary analysis of future design concepts.

836

Giannini Controls Corp. [Astromechanics Research Div.] Malvern, Pa.

SEPARATED FLOW IN CURVED CHANNELS WITH SECONDARY INJECTION, by H. A. Curtiss, O. G. Feil, and D. J. Liquornik. May 25, 1964, 44p. (Rept. no. TR-020-01) (AFOSR-64-0860) (AF 49(638)1218) AD 602487   Unclassified

Injection of secondary fluid flow into a primary flow confined in a curved channel is shown to be a powerful technique for use in fluid state amplification. The secondary injection continuously and progressively alters the separation characteristics of the confined primary flow, resulting in large proportional changes in the channel output flows. A fundamental study of the method with incompressible, turbulent boundary layer flow in a range of varying curvature channels was conducted to learn about the flow characteristics and passage shape parameters relevant to proportional amplification. Several injection methods and velocities were investigated with the main emphasis on the effects of this injection on the flow characteristics within the channels. Preliminary analytical techniques were developed which compared favorably with the experimental results. An overall comparison of the mass flow and momentum gains obtainable for various injection and channel configurations is presented.

837

Giannini Scientific Corp., Santa Ana, Calif.

EXPERIMENTAL RESULTS IN HIGH-SPECIFIC-IM-PULSE THERMO-IONIC ACCELERATION, by A. C. Ducati, G. M. Giannini, and E. Muehlberger. [1964] [3]p. incl. diagr. tables. (AFOSR-64-2032) (AF 49-(638)1161) AD 451197   Unclassified

Also published in AIAA Jour., v. 2: 1452-1454, Aug. 1964.

Using hydrogen as a propellant, specific impulse values in excess of 10,000 sec (corresponding to an exhaust velocity of approximately 60 miles/sec) have been achieved. Although the flowaccelerating mechanisms of this thrustor are not yet completely understood, research work is progressing in both the analytical and experimental phases. Based on experimental results, it is believed that the thermoionic thrustor can attain specific impulse values approaching 2 000 sec and thrust density values of over 200 psf (of thrusting area). The thermo-ionic thrustor retains the arcjet engine's advantages of beam neutralization, comparatively high thrust, simple power-conditioning requirements, and compact size. In addition, it can operate at constant specific impulse by changing the electrical power input and propellant flow rate.

838

Giannini Scientific Corp., Santa Ana, Calif.

HIGH SPECIFIC IMPULSE THERMO-IONIC ACCELERATION, by A. C. Ducati, E. Muehlberger, and G. Giannini. [1964] [21]p. incl. illus. diagrs. table. (AIAA paper no. 64-668) (AFOSR-64-2033) (AF 49-(638)1161) AD 451184   Unclassified

Presented at AIAA Fourth Electric Propulsion Conf., Philadelphia, Pa., Aug. 31- Sept. 2, 1964.

The low arc chamber pressure is one of the basic operating conditions of the high specific impulse thrustor. The hollow anode remains the largest development problem. The anode heats up to an extremely high temperature and then melts. A method to spread the discharge of a hydrogen arc column on a wide surface of the anode has not yet been found. The arc has a tendency to stick in a single spot of the anode producing extremely high current densities which result in damage to the parts. Operation at still lower pressures might help, but the results are not known. The easiest artifice to avoid a high current density on the anode is to rotate the arc in such a way that a spot appears only a fraction of the time in any particular position. At very high current levels the anode spot tends to remain along the shortest path of the current. To avoid this and to produce an arc attachment without any preferred position, perfect symmetry of the connection is necessary. In this case a relatively weak magnetic field introduced at the right point will cause the rotation of the anode spot. With a few turns in series with the arc, perfect rotation can be obtained if the symmetry of the connections is good.

839

Glasgow U. Dept. of Chemistry (Scotland).

STUDIES IN RING EXPANSION, by G. L. Buchanan.
Dec. 31, 1964, 35p. (Scientific rept. no. 2)
(AF EOAR-63-36) AD 628733   Unclassified

'n contrast to an enolizable dimedone derivative, the
non-enolizable 2-methyl-2-(2'-benzoyl ethyl)-dimedone
was cyclised to 1-methyl-4-phenyl bicyclo (3, 3, 1)non-
?-en -8. 9-dione. The infrared spectrum of this and
other non-enolizable β diketones shows a split carbonyl
band. This phenomenon was investigated. A new cy-
cloheptene synthesis previously reported was applied
to the synthesis of a compound related to the alkaloid
colchicine.

840

Gothenburg U. [Dept. of Biology] (Sweden).

INVERSE ENZYMATIC CHANGES IN NEURONS AND
GLIA DURING INCREASED FUNCTION AND HYPOXIA,
by A. Hamberger and H. Hyden. [1963] [5]p. (AFOSR-
J467) (AF 61(052)248) AD 407894   Unclassified

Also published in Jour. Cell Biol., v. 16: 521-525,
1963.

Following stimulation of the vestibular nerve in the
rabbit, respiratory enzyme activities increased in
Deiters' nerve cells. The anaerobic glycolysis was
found to decrease concomitantly by 25 to 40%, suggest-
ing a Pasteur effect. By contrast, in the surrounding
glia the anaerobic glycolysis increased and the respi-
ratory enzyme activity decreased, suggesting a Crab-
tree effect. The evidence is discussed for a regula-
tory metabolic mechanism operating between the neu-
tron and its glia. Hypoxia of 8% O_2 caused an increase
of both oxygen consumption and CO_2 production in the
nerve cells, but did not change the glia values.

841

Gothenburg U. [Dept. of Biology] (Sweden).

A BIOCHEMICAL GLIA ERROR IN THE PARKINSON
DISEASE, by G. Gomirato and H. Hyden. [1963] [8]p.
(AFOSR-64-1062) (AF 61(052)248) AD 441505
                                        Unclassified

Also published in Brain, v. 86: 773-780, 1963.

Biopsies of globus pallidus from cases of Parkinson's
disease were analyzed by microchemical methods with
respect to the amounts and the base compositions of
the glial and the neuronal RNA. In pronounced cases
of Parkinson's disease, increased amounts of RNA
were found in both glial and neurons. The glial RNA
base composition was markedly altered, with in-
creased adenine and decreased guarine and uracil val-
ues. The nerve cell RNA showed less pronounced
changes. Bilateral RNA analyses of one case per-
mitted a timing and correlation of biochemical and

clinical findings. The conclusion was drawn that in the
three-link chain: glial-neuroneffector organ, the pri-
mary biochemical error of the glia in Parkinson's dis-
ease secondarily affects the RNA synthesis of the neu-
ron, manifesting itself finally in muscle tremor and
rigidity.

842

Gothenburg U. [Dept. of Biology] (Sweden).

RNA—A FUNCTIONAL CHARACTERISTIC OF THE
NEURON AND ITS GLIA, by H. Hyden. [1964] [40]p.
incl. illus. diagrs. tables, refs. (AFOSR-65-1500)
(AF 61(052)248) AD 623057   Unclassified

Also published in Brain Function: RNA and Brain Func-
tion; Memory and Learning; Proc. Second Conf.,
Los Angeles, Calif., 1962, Los Angeles, Calif. U.
Press, v. 2: 29-68, 1964. (AFOSR-65-1499)

A discussion is presented of functional aspects of brain
RNA and the relationship between the neuron and its
glia. Special emphasis has been placed on compart-
mentalization of the brain RNA, quantitative aspects,
and base composition characteristics, even of frac-
tions of nerve cells. The distribution of brain RNA,
as well as the characteristics of neuronal RNA and
glial RNA during stimulation and during a learning ex-
periment are discussed.

843

Gothenburg U. [Dept. of Biology] (Sweden).

RESEARCH ON INTRA NEURONAL MECHANISMS FOR
INFORMATION STORAGE, by H. Hyden. Mar. 31,
1963, 7p. (Technical rept. no. 1) (AFOSR-4845)
(AF EOAR-62-29) AD 413650   Unclassified

This report describes microchemical and biophysical
analyses of neurons and the glia surrounding each nerve
cell body. The aid was to study, on the cellular level,
the amount and composition of RNA, the amount of pro-
teins, respiratory enzyme and ATP-ase activities dur-
ing stimulation and in a learning situation in rats. Iso-
lated, fresh cells were used for these studies. In-
verse biochemical changes and result of kinetic studies
showed that the neuron and its glia are linked in an en-
ergetic system. This inverse relationship between
neuron and glia was shown to exist also with respect to
RNA synthesis. The rate of the enzyme reactions in-
creased by 100% in the neuron due to stimulation. The
glia, however, did not change in that respect.

844

Gothenburg U. [Dept. of Biology] (Sweden).

CHANGES IN RNA CONTENT AND BASE COMPOSI-
TION IN CORTICAL NEURONS OF RATS IN A LEARN-
ING EXPERIMENT INVOLVING TRANSFER OF HAND-
EDNESS, by H. Hyden and E. Egyhazi. [1964] [6]p.
incl. illus. diagrs. tables, refs. (AFOSR-65-2518)
(AF EOAR-63-28) AD 628366   Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 52: 1030-1035, Oct. 1964.

The RNA content and base ratios of cortical neurons were studied in rats during transfer of handedness. Corresponding neurons in the contralateral part of the same cortex served as controls. The RNA content increased significantly in these neurons which have large nuclei relative to the cytoplasmi mass. The (G + C)/(A + U) ratio of the RNA decreased, indicating that the new RNA produced during learning is of the messenger type.

845

Gothenburg U. Dept. of Pharmacology (Sweden).

FUNCTIONAL SIGNIFICANCE OF DRUG-INDUCED CHANGES IN BRAIN MONOAMINE LEVELS, by A. Carlsson. [1964] [19]p. incl. diagrs. refs. (AFOSR-4851) (AF EOAR-61-44) AD 413972   Unclassified

Also published in Prog. Brain Research, v. 8: 9-27, 1964.

The actions of various agents interfering with formation, degradation, storage, and release of catecholamines and 5-hydroxytryptamine is discussed in the light of recent evidence that these monoamines serve as transmitters in the central nervous system. Depletion of transmitter stores can be brought about by different mechanisms, which are not equivalent from the functional point of view. Blockade of monoamine uptake by the storage granules produced by reserpine thus leads to depletion of the transmitter stores and to blockade of transmission. On the other hand, displacement of transmitter from the storage sites of the granules by less active transmitter analogues, e.g. metaraminol (formed from a-methyl-m-tyrosine) and D-adrenaline, does not result in any readily detectable impairment of transmission. Thus blockade of the uptake mechanism of the storage granules seems to be an essential component in the action of reserpine. This is further supported by the better time correlation of the pharmacological actions of reserpine to the blockade of the uptake mechanism than to the tissue amine levels. The data support the view that the granules do not merely serve as stores of transmitter but are directly involved in the transmission mechanism. The usefulness and limitations of various agents, e.g. monoamine precursors and analogues, and inhibitors of enzymes responsible for the formation and degradation of monoamines are discussed. The pitfalls arising from the lack of a direct correlation between amine levels and functions are emphasized.

846

Gothenburg U. Dept. of Pharmacology (Sweden).

EVIDENCE FOR A ROLE OF DOPAMINE IN EXTRA-PYRAMIDAL FUNCTIONS, by A. Carlsson. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-0943) (AF EOAR-61-44) AD 617981   Unclassified

Also published in Acta Neuroveget., v. 26: 484-493, 1964.

Dopamine (=3-hydroxytyramine) is the immediate precursor in the biosynthesis of noradrenaline. In brain it probably also serves as a neurotransmitter, particularly in the extrapyramidal system. About 80% of the brain dopamine occur in the neostriatum. The intraneuronal localization of dopamine has been demonstrated by means of histochemical techniques. Reserpine causes dopamine to disappear from the brain and producer a parkinsonian syndrome. The central actions of reserpine can be partially counteracted by increasing the concentration of dopamine in brain through administration of the precursor L-3,4-dihydrophenyla-lanine = L-DOPA. In brains of parkinson patients the concentration of dopamine has been found markedly lowered; the parkinson syndrome is favorably influenced by increasing the dopamine concentration through L-DOPA administration.

847

Gothenburg U. [Dept. of Pharmacology] (Sweden).

BIOCHEMISTRY AND PHYSIOLOGY OF BRAIN DOPAMINE, by A. Carlsson. Feb. 8, 1964, 13p. (AFOSR-64-0737) (AF EOAR-63-14) AD 436491   Unclassified

Dopamine is a catecholamine, formerly known as an intermediate in the formation of noradrenaline and adrenaline. Recent studies indicate that it also serves a function of its own. It occurs in particularly high concentrations in certain parts of mammalian brain, e.g., the corpus striatum. It has become possible to localize dopamine at the cellular level by means of a histochemical technique. Dopamine has been shown to occur in neurons and probably serves as a transmitter. Dopamine occurs in different functional systems. In the retina it appears to be involved in the control of light sensitivity, and in the median eminence in the control of anterior pituitary secretions. In the corpus striatum and certain parts of the brain stem it appears to function at a high level of integration and may play an important role in the syndromes induced by e.g. reserpine and chlorpromazine, both of which interfere with dopamine metabolism.

848

Gothenburg U. [Dept. of Pharmacology] (Sweden).

ANALYSIS OF THE Mg^{++} ATP DEPENDENT STORAGE MECHANISM IN THE AMINE GRANULES OF THE ADRENAL MEDULLA, by A. Carlsson, N.-A. Hillarp, and B. Waldeck. [1963] [38]p. (AFOSR-64-1167) (AF EOAR-63-14) AD 442786   Unclassified

Also published in Acta Physiol. Scand., v. 59: Suppl. 215: 5-38, 1963.

Bovine adrenal medullary granules were isolated and incubated with radioactive adrenaline, noradrenaline, dopamine, hydroxytryptamine or tyramine. The influence of various factors on the uptake of these

monoamines was studied. A large number of enzyme inhibitors have been tested. The most significant findings so far is that -SH groups seem to be essential for the uptake mechanism. A lipid component or nonpolar sites in a protein structure seem to be essential. A number of adrenergic blocking agents caused a blockade of the amine uptake, suggesting structural similarity between binding sites of the uptake mechanism and adrenergic receptors. Segontin (N-(diphenylpropyl)-amphetamine) proved to be the most potent inhibitor of the uptake mechanism known so far, apart from reserpine.

849

Gothenburg U. [Dept. of Pharmacology] (Sweden).

EFFECT OF CHLORPROMAZINE OR HALOPERIDOL ON FORMATION OF 3-METHOXYTYRAMINE AND NORMETANEPHRINE IN MOUSE BRAIN, by A. Carlsson and M. Lindqvist. [1963] [5]p. (AFOSR-64-1169) (AF EOAR-63-14) AD 442788   Unclassified

Also published in Acta Pharmacol. Toxicol., v. 20: 140-144, 1963.

The accumulation in mouse brain of the catecholamine metabolites 3-methoxytyramine and normetanephrine brought about by inhibition of monoamine oxidase was found to be enhanced by small doses of chlorpromazine and haloperidol, but phenoxybenzamine (bensylyt) and promethazine were ineffective. Hypothermia could be eliminated as a causative factor. The effect is, it is suggested, due to a compensatory activation of monoaminergic neurons after blockade of monoaminergic receptors.

850

Gothenburg U. [Dept. of Pharmacology] (Sweden).

EFFECTS OF SOME PHARMACOLOGICALLY ACTIVE AMINES ON THE UPTAKE OF ARYLALKYLAMINES BY ADRENAL MEDULLARY GRANULES, by J. Jonasson, E. Rosengren, and B. Waldeck. [1964] [5]p. (AFOSR-64-1186) (AF EOAR-63-14) AD 442790
Unclassified

Also published in Acta Physiol. Scand., v. 60: 136-140, 1964.

The effects of reserpine, chlorpromazine and related compounds on the uptake of catecholamines by the adrenal medullary granules from the cow has been studied in vitro. Both types of drugs were found to be competitive inhibitors of the adrenaline uptake by the granules. Thus they compete with adrenaline for the same groups in the uptake mechanism for catecholamines. Tryptamine was also found to accumulate in the granules but not by the same mechanism as used by the catecholamines and 5-hydroxytryptamine, as Mg^{++}, ATP and reserpine did not have any influence on the uptake. The K_m values for the uptake of adrenaline and 5-hydroxytryptamine were 8×10^{-4} and 1.1×10^{-4} respectively.

851

Gothenburg U. [Dept. of Pharmacology] (Sweden).

EVIDENCE OF DOPAMINE-CONTAINING NEURONS IN THE RETINA OF RABBITS, by J. Haggendal and T. Malmfors. [1963] [2]p. (AFOSR-64-1187) (AF EOAR-63-14) AD 442792   Unclassified

Also published in Acta Physiol. Scand., v. 59: 295-296, 1963.

This investigation was performed in order to study the identity of the catechol amine found in the retina. The experiments were performed on rabbits, one on retinas from 4 animals and another on retinas and choroids from 13 both albino and pigmented rabbits. The results show that dopamine is the dominating catechol amine in the retina of rabbits. The noradrenaline found in the retina is probably localized to the adrenergic neurons demonstrated there with the fluorescence microscopical technique. From biochemical experiments such treatment lowers the noradrenaline level while the dopamine level in the brain is only slightly influenced.

852

Gothenburg U. Dept. of Pharmacology (Sweden).

TIME CORRELATION BETWEEN THE EFFECTS OF RESERPINE ON BEHAVIOUR AND STORAGE MECHANISM FOR ARYLALKYLAMINES, by A. Carlsson, J. Jonasson, and E. Rosengren. [1963] [4]p. incl. diagr. (AFOSR-64-2162) (AF EOAR-63-14) AD 451923
Unclassified

Also published in Acta Physiol. Scand., v. 59: 474-477, 1963.

The time course of the effect of reserpine on the ability of the adrenal medullary granules to take up arylalkylamines in vivo has been studied. It was observed that there was a closer correlation in time between effects of the drug on the uptake of the amines by the granules and behavior than between the latter and the tissue amine content. The finding is in accordance with a hypothesis that new-formed arylalkylamines are at first transferred to sites in the granules where they are easily available for physiological release.

853

Gothenburg U. Dept. of Pharmacology (Sweden).

BRAIN AND HEART CATECHOLAMINE LEVELS AFTER L-DOPA ADMINISTRATION IN RESERPINE TREATED MICE: CORRELATIONS WITH A CONDITIONED AVOIDANCE RESPONSE, by L. S. Seiden and A. Carlsson. [1964] [4]p. incl. diagrs. (AFOSR-64-2163) (AF EOAR-63-14) AD 451924   Unclassified

Also published in Psychopharmacologia, v. 5: 178-181, 1964.

Mice were tested with reserpine before receiving an injection of L-DOPA. At various times after the

L-DOPA injection they were sacrificed and the brains
and hearts were analyzed for their catecholamine con-
tent. Effects on the conditioned avoidance response
were further analyzed using reserpine and L-DOPA,
and the correlations between the two were discussed.
(Contractor's abstract)

854

Gothenburg U. Dept. of Pharmacology (Sweden).

β-HYDROXYLATION OF TYRAMINE IN VIVO, by A.
Carlsson and B. Waldeck. [1963] [4]p. incl. diagr.
table. (AFOSR-64-2164) (AF EOAR-63-14) AD 452029
Unclassified

Also published in Acta Pharmacol. Toxicol., v. 20:
371-374, 1963.

The rapid formation of octopamine from tyramine by
adrenergic nerves is demonstrated in vivo. Evidence
in support of the existence of both intra- and extra-
neuronal binding sites for tyramine is presented. The
further investigation of these phenomena may throw
light on the pharmacological actions of indirectly act-
ing sympathomimetics. (Contractor's abstract)

855

Gothenburg U. Dept. of Pharmacology (Sweden).

DISCLOSURE OF LABILE MONOAMINE FRACTIONS
IN BRAIN AND THEIR CORRELATION TO BEHAV-
IOUR, by J. Haggendal and M. Lindqvist. [1964] [7]p.
incl. diagrs. table, refs. (AFOSR-64-2165)
(AF EOAR-63-14) AD 452024   Unclassified

Also published in Acta Physiol. Scand., v. 60: 351-
356, 1964.

The recovery rates of brain monoamines after dis-
ruption of long-term treatment of rabbits with reser-
pine (0.2 mg/kg/day) and after single doses of the drug
(0.2 and 1.0 mg/kg) have been compared. No clearcut
difference in recovery rates between the two types of
treatment could be detected. In both cases normal
values were reached only after several weeks. From
the 3rd to the 4th day the animals showed a normal
gross behavior in spite of low monoamine levels.
Brain monoamines and behavior were studied in chron-
ically treated rabbits during the 24 hrs following the
daily injection. A temporal correlation between the
changes in the remaining low monoamine levels and be-
havior was demonstrated, which is in contrast to ob-
servations made in animals receiving a single dose
for the first time. It appears that chronic reserpine
treatment results in removal of large physiologically
inert monoamine fractions, thus disclosing small, la-
bile, functionally essential fractions.

856

Gothenburg U. Dept. of Pharmacology (Sweden).

EFFECTS OF CHLORPROMAZINE, HALOPERIDOL

AND RESERPINE ON THE LEVELS OF PHENOLIC
ACIDS IN RABBIT CORPUS STRIATUM, by N.-E.
Andén B.-E. Roos, and B. Werdinius. [1964] [10]p.
incl. diagrs. table, refs. (AFOSR-64-2369)
(AF EOAR-63-14) AD 452340   Unclassified

Also published in Life Sci., v. 3: 149-158, 1964.

Chlorpromazine and haloperidol produce a transient in-
crease of 3, 4-dihydroxyphenylacetic acid and a some-
what slower, more prolonged increase of homovanillic
acid in the rabbit corpus striatum. Phenoxybenzamine,
promethazine and pentobarbital were ineffective. Res-
erpine gave the same effects but a little more long-
lasting rise as regards homovanillic acid. It seems as
if chlorpromazine and haloperidol reduce the elimina-
tion rate of these acids and possibly also increase their
synthesis. The effects of reserpine may presumably
be explained by the depletion of the dopamine and, in
addition, by a delayed disappearance of the acids.
(Contractor's abstract)

857

Gothenburg U. Dept. of Pharmacology (Sweden).

A METHOD FOR THE FLUORIMETRIC DETERMINA-
TION OF 3-METHOXYTYRAMINE IN TISSUES AND
THE OCCURRENCE OF THIS AMINE IN BRAIN, by A.
Carlsson and B. Waldeck. [1964] [6]p. incl. diagrs.
tables, refs. (AFOSR-65-1292) (AF EOAR-63-14)
AD 620709   Unclassified

Also published in Scand. Jour. Clin. and Lab. Invest.,
v. 16: 133-138, 1964.

A fluorimetric method for the determination of small
amounts of 3-methoxytyramine, (MT), in tissues is
described. After separation on ion-exchange column,
MT is converted to a strongly fluorescent compound.
Interference of dopamine (DA), is eliminated either by
column separation or differential oxidation. MT is
demonstrated in brain of some mammals indicating a
role of catechol-O-methyl transferase in the degrada-
tion of DA in this tissue. (Contractor's abstract)

858

Gothenburg U. Dept. of Pharmacology (Sweden).

DEMONSTRATION AND MAPPING OUT OF NIGRO-
NEOSTRIATAL DOPAMINE NEURONS, by N.-E.
Andén, A. Carlsson and others. [1964] [8]p. incl.
refs. (AFOSR-64-1858) (AF EOAR-64-30) AD 450102
Unclassified

Also published in Life Sci., v. 3: 523-530, 1964.

In normal rats, dopamine-storing nerve terminals are
found in the neostriatum and dopamine-containing nerve
cells in the substantia nigra, mainly in the pars com-
pacta. After electrolytic lesions in the substantia nigra
or the internal capsule the histochemical fluorescence
and the dopamine content of the neostriatum were
markedly reduced. Removal of the neostriatum pro-
duced an increased fluorescence of the dopamine nerve

cells of the substantia nigra and of their axons central to the lesion. These axons ascend as a nerve tract in the internal capsule towards the neostriatum. The data give strong evidence for the existence of nigro-neo-striatal dopamine neurons, which probably contain most or all of the dopamine present in the neostriatum. (Contractor's abstract)

859

Gothenburg U. Dept. of Statistics (Sweden).

SELECTED BIBLIOGRAPHY ON NON-NORMALITY, ed. by H. Hyrenius, I. Adolfsson and others. Göteborg, Elanders Boktryckeri Aktiebolag, 1964, 108p. incl. refs. (Publication no. 12) (AFOSR-65-1030) (AF 81(052)459) AD 817929   Unclassified

The bibliography presented is a part of a larger research project, which is designed to study the effects on normal-theory statistical methods arising when the underlying assumption of a normal universe is not fulfilled. Only abstracts from the most important scientific journals plus those further references which were found in articles in these journals are included.

880

Göttingen U. [Inst. of Physiology] (Germany).

ELECTROPHYSIOLOGICAL STUDIES OF THE OLFACTORY BULB, by R. Von Baumgarten. Final technical rept. Sept. 30, 1963, 17p. (AFOSR-J1318) (AF EOAR-82-93) AD 424238   Unclassified

Studies on the neuropharmacological influence on single nerve cells, the slow-wave activity, and behavioral mechanisms of the olfactory bulb were performed in rabbits and fish. The effects of electrophoretic administration of acetylcholine, noradrenaline, and serotonin to single nerve cells in the olfactory bulb was investigated using 5-barreled micropipette electrodes. The majority of sensitive cells responded to electrophoretic administration of acetylcholine, noradrenaline, and serotonin by a decrease in their spontaneous rate of activity. The onset of the effect and the return to control levels of activity were delayed in each instance (2-10 sec and 3-20 sec respectively).

881

Grafix, Inc., Albuquerque, N. M.

A GENERAL ADAPTIVE MOTOR LEARNING PROGRAM FOR A DIGITAL COMPUTER, PART I, SECTIONS I AND II, by G. R. Bussey. Final technical rept. Dec. 30, 1964, 99p. (AFOSR-85-0275, Pt. 1) (AF 49(838)1203) AD 611334   Unclassified

The goal of this research effort is the ultimate realization of a practical adaptive system which would be an adequate basis for a robot with manlike capabilities-- say, one filling the role of man in an unhospitable space environment. Consequently, and effort has been made from the very beginning to incorporate the

rudiments of all the major subsystems thought necessary and to attain a realistic drive subsystem of the complexity believed essential to an automation which not only has a variety of jobs to do but must in addition improve itself in general and take care of its physical needs. Because some successful work had already been done in the area of perception, it was decided to concentrate on the effector or motor side of the adaptive system problem, with the perceptual processes being merely simulated at first by any practical means at hand.

882

Grafix, Inc., Albuquerque, N. M.

A GENERAL ADAPTIVE MOTOR LEARNING PROGRAM FOR A DIGITAL COMPUTER, PART II, SECTIONS III AND IV, by G. R. Bussey. Final technical rept. Dec. 30, 1964, 107p. (AFOSR-85-0275, Pt. 2) (AF 49-(638)1203) AD 611335   Unclassified

The object of the research has been to achieve a working program that effectively demonstrates a general ability to learn non-specific motor tasks. Thus, the report consists of a working computer program. The program is described in detail with explanatory text keyed to flow charts. The program is given, along with instructions for running it.

863

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

AIR VEHICLE FLIGHT PATH OPTIMIZATION. Final status rept. May 1963, 38p. (AFOSR-4907) (AF 29-(800)2671) AD 415465   Unclassified

The means generally available for treatment of optimal air vehicle flight paths are limited from the viewpoint of practical numerical computations. The method of gradients has been applied to air vehicle problems of maximum range, minimum fuel, and minimum time subject to various constraints with considerable success. Two versions of the gradient method, gradient projection and a gradient/penalty function technique for handling terminal constraints have been employed. An integral form of penalty function has been introduced for incorporation of two limit boundaries in the altitude-Mach number chart: one a minimum altitude limit and the second a Mach number versus altitude envelope corresponding to powerplant and structural limitations. The differing versions of the gradient method have been investigated in range, fuel, and time computations for a hypothetical Mach 3 vehicle, the aim being to assess the relative merits of these versions from the viewpoint of speed of convergence of the successive approximations scheme.

864

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SINGULAR EXTREMALS IN LAWDEN'S PROBLEM OF

OPTIMAL ROCKET FLIGHT, by H. J. Kelley. [1963] [3]p. (AFOSR-J1519) (AF 29(600)2871) AD 427942
Unclassified

Presented at AIAA Summer meeting, Los Angeles, Calif., June 17-20, 1983.

Also published in AIAA Jour., v. 1: 1578-1580, July 1963.

The problem of optimal rocket flight in an inverse square law force field has been studied extensively by Lawden and Leitmann. Periods of zero thrust, intermediate thrust, and maximum thrust are possible subarcs of the solution according to analysis of the Euler-Lagrange equations and the Weierstrass necessary condition. Arcs of intermediate thrust have been examined recently by Lawden; however, the question of whether or not such arcs actually may furnish a minimum has been left unresolved. The singular extremals of Lawden's problem are derived by means of the Legendre-Clebsch necessary condition applied in a transformed system of state and control variables. These are obtained as circular orbits along which the thrust is zero and intermediate thrust arcs are found in Lawden's analysis. Since these solutions satisfy only the weak form of the Legendre-Clebsch condition, i.e., the extremals are singular in the transformed system of variables, the question of their minimality remains unanswered.

885

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

RESEARCH ON "OPTIMIZATION THEORY" AND AEROSPACE APPLICATIONS. Aug. 1983, 33p. (AFOSR-5233) (AF 49(838)1207) AD 415957
Unclassified

The mathematical studies presented include Research in Successive Approximation Techniques, The Relation of Transversal Surface Theory to Necessary Conditions, Study of Singular Extremals, Trefftz-Friedrichs Duality Principle, as well as Optimal Multistage Rocket Flight and Other Discontinuous Variational Problems.

866

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

A TRAJECTORY OPTIMIZATION TECHNIQUE BASED UPON THE THEORY OF THE SECOND VARIATION, by H. J. Kelley, R. E. Kopp, and H. G. Moyer. [1964] [24]p. incl. refs. (AFOSR-84-2413) (AF 49(638)1207) AD 453605
Unclassified

Presented at AIAA Astrodynamics Conf., New Haven, Conn., Aug. 19-21, 1983.

Also published in Prog. Astronaut. and Aeronaut., v. 14: 559-582, 1964.

A successive approximation method based upon the theory of the second variation is developed. In the early stages of computation, the process behaves much like the gradient/penalty function process with boundary conditions met only approximately. In the terminal stage, convergence more rapid than that of a gradient method is achieved with "exact" satisfaction of boundary conditions an integral part of the process. Since the equations of variation of the Euler-Lagrange equations are employed in the computational scheme, only slight additional effort is required to perform a check of the generalized Jacobi (Mayer) condition.

867

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SOLUTION OF VARIATIONAL PROBLEMS BY MEANS OF A GENERALIZED NEWTON-RAPHSON OPERATOR, by R. McGill and P. Kenneth. May 1984, 28p. incl. diagrs. table, refs. (Rept. no. RE-176J) (AFOSR-65-0317) (AF 49(638)1207) AD 481845; AD 611738
Unclassified

Also published in AIAA Jour., v. 2: 1761-1788, Oct. 1964.

This paper presents the development of an indirect method for solving variational problems by means of an algorithm for obtaining the solution to the associated nonlinear two-point boundary value problem. The method departs from the usual indirect procedure of successively integrating the nonlinear equations and adjusting arbitrary initial conditions until the remaining boundary conditions are satisfied. Instead, an operator is introduced which produces a sequence of sets of functions which satisfy the nonlinear system formed by the state equations and the Euler-Lagrange equations. Under appropriate conditions this sequence converges uniformly and rapidly (quadratically) to the solution of the nonlinear boundary value problem. The computational effectiveness of the algorithm is demonstrated by three numerical examples. (Contractor's abstract)

868

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SEVERAL TRAJECTORY OPTIMIZATION TECHNIQUES. PART I: DISCUSSION, by R. E. Kopp and R. McGill. 1983, 25p. incl. refs. (Rept. no. GRD-119, Pt. 1) (AFOSR-65-0318) (AF 49(838)1207) AD 815154
Unclassified

Also published in Computing Methods in Optimization Problems, ed. by A. V. Balakrishnan and L. W. Neustadt. New York, Academic Press, 1984, p. 65-89.

Several numerical approaches for solving problems arising in optimizing trajectories are discussed. The basic concepts underlying the gradient method, the second variation method, and a generalized Newton-Raphson method are presented in a very elementary manner by considering an ordinary minimum problem with a side constraint. The results obtained when the basic concepts are extended to the variational problem and the computational algorithms are then discussed.

Finally, in the concluding remarks, advantages and disadvantages of each method are reviewed, and a comparison is made between the second variation method, which might be considered a direct method, and the generalized Newton-Raphson method, normally considered as an indirect method. Part II of this paper provides an application of the 3 methods to a specific problem. (Contractor's abstract)

839

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SEVERAL TRAJECTORY OPTIMIZATION TECH-
NIQUES. PART II: APPLICATION, by H. G. Moyer
and G. Pinkham. 1983, 11p. incl. diagrs. (Rept. no.
GRD-119, Pt. II) (AFOSR-85-0603) (AF 49(638)1207)
AD 815155   Unclassified

Also published in Computing Methods in Optimization
Problems, ed. by A. V. Balakrishnan and L. W.
Neustadt. New York, Academic Press, 1964, p. 91-
105.

The application of the 3 optimization methods - steepest descent, second variation, and generalized Newton-Raphson - to the problem of minimum time, low thrust, circle-to-circle transfer is discussed. Details of computational techniques that have proved successful in practice are presented. The number of iteration cycles and the time used by the computer are given for each method. (Contractor's abstract)

870

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

DISCONTINUOUS VARIATIONAL PROBLEMS, by H. G.
Moyer. Dec. 1964, 26p. incl. diagrs. refs. (Memo
no. RM-252J) (AFOSR-65-2525) (AF 49(638)1207)
AD 617270   Unclassified

Also published in Proc. IBM Scientific Computing Symposium on Control Theory and Applications, Thomas J. Watson Research Center, Yorktown Heights, N. Y. (Oct. 19-21, 1964), p. 211-221.

This paper analyzes variational problems that specify jump discontinuities in the state variables. The solution extremals are required to jump when they reach a manifold of dimension n-q (n is the number of state variables). Two approaches to these problems are presented. The first approach is geometrical and therefore loses most of its practicality as the number of state variables is increased beyond two. However, it provides valuable diagnostic insight. The boundary of the reachable set is regarded as a wavefront that is determined by wavelets. This principle is used to construct the wavefront just after the discontinuity and to determine the normal to its tangent plane. Of course the Lagrange multiplier vector is parallel to this normal. When q is equal to one there are at most two directions in which the extremal can be continued. The second approach is analytic and therefore much more flexible and powerful. The Lagrange multipliers are obtained from a set of nonlinear equations. They are

underdetermined when q is greater than one. After the discontinuity the extremals fill an n-dimensional volume regardless of the value of q.

871

[Gustavus-Adolphus Coll., St. Peter, Minn.]

OPINION CHANGE AS A FUNCTION OF COMMUNICA-
TION-ATTITUDE DISCREPANCY, by J. O. Whittaker.
[1963] [10]p. incl. diagr. tables. (AFOSR-84-0005)
(AF AFOSR-82-188) AD 435506   Unclassified

Presented at meeting of the Southwestern Psychological Assoc., Dallas, Tex., 1983.

Also published in Psychol. Repts., v. 13: 783-772, 1963.

Experiments were designed to ascertain the relation between extent of change of opinions and the degree of discrepancy. A curvilinear relation was observed in questionnaire data from 107 Ss, i. e., smaller and larger discrepancies had less effect than medium size discrepancies for communications on several different issues and on judgments of autokinetic movement. (Contractor's abstract)

872

[Gustavus-Adolphus Coll., St. Peter, Minn.]

PARAMETERS OF SOCIAL INFLUENCE IN THE AUTO-
KINETIC SITUATION, by J. O. Whittaker. [1964] [8]p.
(AFOSR-64-0837) (AF AFOSR-62-188) AD 438392
                                      Unclassified

Also published in Sociometry, v. 27: 88-95, Mar. 1964.

Two experiments were conducted to determine the effects of a confederate's judgments on those of subjects as a function of the discrepancy or distance between them. In the first experiment, smaller discrepancies produced larger positive judgmental shifts than did discrepancies of greater magnitude. When very small discrepancies were employed in the second experiment, however, it was discovered that a curvilinear relationship exists between judgmental shift and subject-confederate discrepancy.

873

[Gustavus-Adolphus Coll., St. Peter, Minn.]

COGNITIVE DISSONANCE AND THE EFFECTIVENESS
OF PERSUASIVE COMMUNICATIONS, by J. O.
Whittaker. [1984] [9]p. incl. tables, refs. (AFOSR-
85-0595) (AF AFOSR-82-188) AD 814735
                                      Unclassified

Also published in Public Opinion Quart., v. 28: 547-
555, 1984.

Festinger's theory of cognitive dissonance assumes that dissonant cognitive elements create tension and that

dissonance leads to tension-reducing behavior. It follows that the greater the discrepancy between the position taken in the communication and the attitude held by the listener, the greater will be the dissonance and, consequently, the greater the change. The results of this experiment show, however, that an important variable determining the effectiveness of persuasive communications is the discrepancy between the position or stand presented in the communication and the position of the audience. There is an optimal discrepancy that results in maximum shifts; smaller or larger discrepancies yield negligible positive or negative shifts, while extremely large discrepancies cause significant negative or boomerang effects.

674

Hamline U., St. Paul, Minn.

ON GAUSSIAN MEASURES EQUIVALENT TO WIENER MEASURE, by D. E. Varberg. [1964] [12]p. (AFOSR-65-0343) (AF AFOSR-63-35) AD 612436
<div align="right">Unclassified</div>

Also published in Trans. Amer. Math. Soc., v. 113: 262-273, Nov. 1964.

The question is investigated of when 2 Gaussian measures are equivalent in the case where 1 of the measures is Wiener measure. Necessary and sufficient conditions are given for equivalence, and an explicit formula is found for the Radon-Nikodyn derivative. These results are based on a paper by Woodward (Trans. Amer. Math. Soc., v. 100: 459-460, 1961). The sufficiency results are obtained by examining the question of when it is possible to represent a Gaussian process by means of a linear transformation of the Wiener process, and this in turn has led to the consideration of Gaussian processes having factorable covariance functions. (Math. Rev. abstract)

675

Harvard U. Cruft Lab., Cambridge, Mass.

FINITE TIME SELF-OPTIMIZING SYSTEMS, by K. S. Narendra, and L. E. McBride, Jr. Nov. 13, 1963 [27]p. incl. diagrs. (Technical rept. no. 422) (AFOSR-64-0311) (Nonr-186616) AD 430094
<div align="right">Unclassified</div>

A correlation method proposed earlier for the optimization of linear systems by altering parameters to reduce a mean-square error criterion is extended to the cases of transient operation, non-quadratic criteria and time varying systems. Stability analysis indicates that the open-loop self-optimizing system is stable regardless of the speed with which the parameters are altered. When parameters of a closed-loop system are permitted to vary rapidly with time, it is found that the problem becomes analogous to that of optimal terminal control, and its solution is a generalization of the methods of optimal programming. (Contractor's abstract)

876

Harvard U. Cruft Lab., Cambridge, Mass.

LARGE SIGNAL THEORY OF AVALANCHE TRANSISTOR CIRCUIT OPERATION, by J. S.-T. Huang and A. A. Pandiscio. Sept. 16, 1963 [174]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 424) (AFOSR-64-0329) (Nonr-166616) AD 429605
<div align="right">Unclassified</div>

The present study is concerned with the transient analysis of avalanche transistor pulse circuits from which fast current pulses are obtained. The transistor, when properly biased in the avalanche mode, is seen to exhibit a negative resistance at the collector-emitter

terminals. The existence and significance of a reactive element associated with such negative resistance are thoroughly discussed. (Contractor's abstract)

677

Harvard U. Cruft Lab., Cambridge, Mass.

EXISTENCE OF QUADRATIC TYPE LIAPUNOV FUNCTIONS FOR A CLASS OF NONLINEAR SYSTEMS, by K. S. Narendra and R. M. Goldwyn. Aug. 1, 1963, 29p. incl. diagrs. (Technical rept. no. 415) (AFOSR-64-0344) (Nonr-166616)
<div align="right">Unclassified</div>

The report deals with the construction of Liapunov functions for nonlinear systems related to the Lur'e problem. The method presented consists in developing a quadratic type Liapunov function - called a spanning Liapunov function (SLF) - for an associated linear system, and modifying it suitably for the nonlinear case. Using this approach, a theorem of Popov for the Lur'e problem is derived and is extended to the case with "m" nonlinearities. Conditions for the existence of a Liapunov function of this form for the case of a gain $0 < l(c) < \bar{l}$ in the Lur'e problem are derived. The results are used to construct Liapunov functions for certain specific systems. (Contractor's abstract)

876

Harvard U. Cruft Lab., Cambridge, Mass.

NYQUIST'S PROBLEM IN PULSE TRANSMISSION THEORY, by D. W. Tufts. Sept. 20, 1963 [30]p. incl. diagrs. (Technical rept. no. 425) (AFOSR-64-0345) (Nonr-166616) AD 424940
<div align="right">Unclassified</div>

The problem, posed by Nyquist, of jointly optimizing the transmitter and receiver in a pulse amplitude modulation system is reformulated and analyzed in some detail. Nyquist's problem has not been completely solved in this report. The main results are that, using a mean square criterion, the optimum receiver for each message value can be represented as a matched filter followed by a tapped delay line and a sampler. The optimum tap gains are unique, and formulas are given for this set of gains and for the associated value of the mean square error. (Contractor's abstract)

679

Harvard U. Cruft Lab., Cambridge, Mass.

ELECTRIC FIELD EFFECTS IN PARAMAGNETIC RESONANCE, by E. B. Royce. Feb. 12, 1963 [152]p. incl. diagrs. tables, refs. (Technical rept. no. 379) (AFOSR-64-0605) (Nonr-166616) AD 401690
<div align="right">Unclassified</div>

The electric field effects in paramagnetic resonance consists of shifts in resonance frequency produced by the application of a uniform electric field to the magnetic resonance sample. These electric field shifts arise through variations in the crystal field splittings under the influence of the applied electric field. In a

<div align="center">> 182 <</div>

non-piezoelectric sample, two mechanisms are considered to be important in producing the electric field induced variation in crystal field. The optical mode ionic polarization of the crystal lattice, in which the anion and cation sublattices move with respect to each other, produces a variation in the local crystalline environment of the magnetic ion and hence, in its crystal field interaction; the electronic polarization of the magnetic ion alters its interaction with its crystalline surroundings, again producing a variation in the crystalfield interaction. Effects of electrostriction and piezoelectric distortion are mentioned but not treated in this work. (Contractor's abstract)

880

Harvard U. Cruft Lab., Cambridge, Mass.

QUANTUM-THEORETICAL COMPARISON OF NONLINEAR SUSCEPTIBILITIES IN PARAMETRIC MEDIA, LASERS, AND RAMAN LASERS, by N. Bloembergen and Y. R. Shen. July 19, 1983 [49]p. incl. diagrs. refs. (Technical rept. no. 417) (AFOSR-84-0606) (Nonr-186818) AD 417508; AD 418122   Unclassified

General expressions for complex nonlinear susceptibilities in the presence of damping have been derived which describe simultaneously parametric, maser and Raman maser effects. If the applied fields are near resonances of the atomic system and have a magnitude equal to or larger than the linewidths, the different effects become inextricably mixed. It is still possible to consider the total polarization, which is a mixture of all linear and nonlinear effects, as a source term reacting with the electromagnetic fields. Joint equations of the dynamical variables of the modes and the density matrix elements of the general nonlinear medium can be written down, although explicit steady state solutions require the retention of only a few terms in a Fourier series expansion, truncation of non-resonant terms, and other approximations. (Contractor's abstract)

881

Harvard U. Cruft Lab., Cambridge, Mass.

CONDITIONS FOR OPTIMUM DIGITAL COMMUNICATION WITH APPLICATION TO DELTA MODULATION, by T. Fine. Mar. 5, 1963 [41]p. incl. diagrs. refs. (Technical rept. no. 399) (AFOSR-84-0619) (Nonr-186816) AD 405053   Unclassified

A procedure for optimization of a class of binary communication systems is presented and applied. The message set or transmitter input is taken to be a real-valued sample sequence from a stochastic process with discrete parameter. The transmitter may be any time-varying, nonlinear operator with domain of the real valued input and range to the binary numbers. The transmission medium of noisy channel linking the transmitter and receiver is to be characterized by the conditional probabilities of all possible received binary sequences given any transmitted sequence. The receiver may be any real-valued, time-varying, nonlinear operator on the received binary sequences.

The optimization conditions obtained are discussed and the relationship between an optimum communication system and a delta modulation system indicated. It is shown that, for the quadratic loss function and any noisy channel, a delta modulation system is an allowable representation of the optimum binary system. Preliminary results on an extended digital communication system model are discussed and areas for further research are indicated. (Contractor's abstract)

882

Harvard U. Cruft Lab., Cambridge, Mass.

EXTENSIONS OF LINEAR, LEAST-SQUARES SAMPLING THEORY, by D. W. Tufts and N. Johnson. Apr. 10, 1983, 1v. incl. diagrs. refs. (Technical rept. no. 407) (AFOSR-84-0620) (Nonr-188816) AD 411848
Unclassified

This paper presents some new results in the interpolation theory of random processes. These results are applied to the problem of reconstructing a random waveform from instantaneous samples. The main concern is with the removing of some of the restrictions of the interpolation method that is based on the ordinary sampling theory. In particular it is not assumed that an infinite number of samples is available, nor that the sampled random process is band-limited. On the other hand, the authors wish to preserve the practical (but not theoretical) simplicity of the type of interpolation that corresponds to time-invariant filtering. (Contractor's abstract)

883

Harvard U. Cruft Lab., Cambridge, Mass.

GENERATION OF QUADRATIC-TYPE LIAPUNOV FUNCTIONS FOR LINEAR TIME-VARYING SYSTEMS, by K. S. Narendra and R. M. Goldwyn. Nov. 22, 1983 [23]p. incl. diagrs. refs. (Technical rept. no. 421) (AFOSR-84-0689) (Nonr-188818) AD 433982
Unclassified

In this report the existence of Common Liapunov Functions (CLF'S) for linear time-varying systems is discussed. For a negative feedback system with G (s) in the forward path and a gain k (t) in the feedback path, it is shown that a sufficient condition to ensure the existence of CLF and hence stability is that $1/k + G(s)$ be a positive real function. For specific time-varying systems, Liapunov functions that are explicit functions of time are found to increase the stability range of a parameter over that given by the CLF. An analysis of the behavior of the Liapunov function V in the V-V phase plane yields further insight into the problem of stability and leads to the generation of Liapunov functions for an additional class of time-varying systems. In the final section this approach is compared with the well-known Floquet Theory for periodic systems. (Contractor's abstract)

884

Harvard U. Cruft Lab., Cambridge, Mass.

AN ADAPTIVE PROCEDURE FOR CONTROLLING UNDEFINED LINEAR PROCESSES, by K. S. Narendra and D. N. Streeter. Nov. 8, 1963 [32]p. incl. diagrs. tables. (Technical rept. no. 420) (AFOSR-64-0690) (Nonr-186616) AD 434895   Unclassified

An adaptive procedure is described and demonstrated which causes a reduction of the mean-square error of a linear stationary random process, without explicit knowledge of the characteristics of the process. The procedure involves recursive simultaneous adjustment of an arbitrary number of parameters in a feedback compensator. The adjustment is based on estimations of the error gradient in the space of the adjustable parameters. (Contractor's abstract)

885

Harvard U. Cruft Lab., Cambridge, Mass.

ON THE PARTIAL DIFFERENTIAL EQUATION FOR THE CONDITIONAL PROBABILITY DISTRIBUTION FOR NONLINEAR DYNAMIC SYSTEMS WITH NOISY MEASUREMENTS, by R. L. Kashyap. Dec. 2, 1963, 18p. (Technical rept. no. 432) (AFOSR-64-0691) (Nonr-186616)   Unclassified

The partial integro-differential equation has been derived for the conditional probability density distribution of the output of a nonlinear system excited by non-additive white Gaussian noise, with nonlinear measurements corrupted by white Gaussian noise. This equation reduces to the well-known Kolmogoroff forward equation when there are no measurements. The usefulness of the differential equation is demonstrated by deriving from it, for linear systems, the Wiener-Kalman filter.

886

Harvard U. Cruft Lab., Cambridge, Mass.

OPTIMUM PULSE SHAPES FOR TRANSMITTERS WHICH ARE BOTH PEAK POWER LIMITED AND AVERAGE POWER LIMITED, by D. W. Tufts and D. A. Shnidman. Nov. 12, 1963 [16]p. incl. diagrs. (Technical rept. no. 428) (AFOSR-64-0693) (Nonr-186616) AD 434875   Unclassified

For any stable linear system, an explicit formula is derived for the input waveform p(t) which maximizes the output waveform amplitude at a prescribed time instant. The problem and the results are closely related to the matched filter problem of radar theory and the bang-bang problem of optimal control theory. In addition to the obvious direct applications in signal design, the results can also be used indirectly since they provide a standard of performance for more realistic situations where additional constraints are important.

887

Harvard U. Cruft Lab., Cambridge, Mass.

A LOCK-ON PROBABILITY ANALYSIS FOR THE INITIAL SYNCHRONIZATION OF PHASE-LOCKED LOOPS, by R. J. McLaughlin. Feb. 3, 1963 [91]p. incl. diagrs. refs. (Technical rept. no. 372) (AFOSR-64-0904) (Nonr-186616) AD 433689   Unclassified

This report presents a general method for the calculation of the lock-on time as a function of the initial phase (angular) error and initial frequency (angular velocity) error, in the absence of noise, with particular reference to the specially-important phase-locked-loop characterized by a nonlinear differential equation. As a result of the presence of saddle-points in the phase-space of the differential equations of phase-locked loops, it is shown that for any value of the initial frequency error, the lock-on time will be indefinitely large for a value of the initial phase error sufficiently close to a saddle-point separatrix, and that the lock-on time varies as the negative logarithm of the distance of the initial point from the separatrix when this distance is sufficiently small. An explicit formula is given for the equation for the phase-locked-loop. (Contractor's abstract)

888

Harvard U. Cruft Lab., Cambridge, Mass.

TEMPERATURE DEPENDENCE OF OPTICAL HARMONIC GENERATION IN KH_2PO_4 FERROELECTRICS, by J. P. van der Ziel. Apr. 7, 1964, 1v. incl. illus. diagrs. tables, refs. (Technical rept. no. 431) (AFOSR-64-1344) (Nonr-186616) AD 601393   Unclassified

Optical second harmonic generation from KH_2PO_4 and KD_2PO_4 platelets was measured as a function of temperature, above and below the ferroelectric transition point, between 77°K and 300°K. The nonlinear process is expressed by a third rank susceptibility tensor relating the second harmonic polarization to a quadratic function of the applied fields. A phenomenological theory is developed to account for the observed changes in the linear and nonlinear susceptibilities at the transition point. Relations between the tensor elements above and below the ferroelectric transition are obtained. The difficulties encountered in the experiment in the ferroelectric phase due to domains, and in the interpretation of the experimental data are discussed. The effects of atomic substitution on the relative values of the second harmonic susceptibilities wa investigated by measurements at 300°K on the followin isomorphs: KH_2PO_4, KH_2AsO_4, KD_2PO_4 and $NH_4H_2F_4$. These substitutions have important effects on the low frequency dielectric and linear optical properties.

889

Harvard U. Cruft Lab., Cambridge, Mass.

STARK EFFECTS ON THE QUADRUPOLE COUPLING

OF Cl^{35} IN SODIUM CHLORATE, by F. A. Collins. Jan. 21, 1964, 73p. incl. diagrs. tables, refs. (Technical rept. no. 435) (AFOSR-64-1346) (Nonr-186816) AD 601428　　　　　　Unclassified

It is shown that the direct response of the covalently bonded chlorate group to fields and field gradients is equally as important as the solid state effects due to local field effects and the change in the lattice-sum contribution to the quadrupole coupling.

890

Harvard U. Cruft Lab., Cambridge, Mass.

SOME INEQUALITY CONSTRAINT PROBLEMS IN THE CALCULUS OF VARIATIONS, by W. F. Denham. Apr. 16, 1964, 24p. incl. diagrs. (Technical rept. no. 436) (AFOSR-64-1347) (Nonr-186616) AD 601842
　　　　　　Unclassified

Four related memoranda dealing with inequality constraints in the calculus of variations are collected in this report. The first is a detailed derivation of the solution to a problem appearing in (AIAA Jour., v. 1: 2544-2550, 1963). The second is the solution to the simplest possible problem including both a control variable and a state variable inequality constraint. The third adds a slight complexity to the second leading to transcendental equations in the solution. The fourth is a description of a straightforward method of calculating neighboring extremal paths when an interval of the nominal extremal is on a control variable or a first-order state variable inequality constraint boundary. (Contractor's abstract)

891

Harvard U. Cruft Lab., Cambridge, Mass.

ON THE CONJUGATE POINT CONDITION FOR THE CONTROL PROBLEM, by J. V. Breakwell and Y.-C. Ho. Mar. 26, 1964, 1v. incl. diagrs. (Technical rept. no. 441) (AFOSR-64-1348) (Nonr-186618) AD 601392
　　　　　　Unclassified

In this report the conjugate point condition was derived in the classical calculus of variations from a control-theoretic point of view. The relationship of conjugate point condition to relative minimum in optimal control problem is discussed. (Contractor's abstract)

892

Harvard U. Cruft Lab., Cambridge, Mass.

INTERACTION OF SIGNAL AND NOISE IN A NON-LINEAR SYSTEM, by P. Trafton and D. W. Tufts. July 27, 1964 [48]p. incl. diagrs. (Technical rept. no. 450) (AFOSR-64-2214) (Nonr-186618) AD 607255
　　　　　　Unclassified

An experimental system has been constructed which simulates the detection stage of a receiver. With the

application of periodic bursts of sine-wave plus Gaussian noise at the input, the output of this system is a nonstationary random process. The addition of noise to the signal suppresses the mean at the output for the half-wave linear detector. However, the mean is unchanged for the half-wave square-law detector. The non-stationary variance is seen to vary between two values which can be easily measured. Output signal-to-noise ratio is greater for the half-wave square-law device than for the half-wave linear device. Addition of a clipper to the half-wave linear device decreases the signal-to-noise ratio. Detection characteristics of the half-wave linear and half-wave square-law devices are found to be equivalent and the clipper degrades the detection characteristic. (Contractor's abstract)

893

Harvard U. Cruft Lab., Cambridge, Mass.

GENERATING FUNCTIONS OF ABSTRACT GRAPHS WITH APPLICATIONS, by C. V. Ramamoorthy and D. W. Tufts. Mar. 24, 1964 [59]p. incl. diagr. refs. (Technical rept. no. 439) (AFOSR-64-2215) (Nonr-186618) AD 607254　　　　　　Unclassified

The generating function of a graph is a function of the complex variable z which has the property that interesting attributes of the graph can be extracted from it by numerical operations. The generating function can be written as a standard rational function of z, and the denominator is called the characteristic function of the graph. This latter function can also be obtained independently. The computation of the generating function involves either matrix inversions or application of formulas that take into account the topological characteristics of the graph. When the given graph has certain orderly topological features, the topological method gives the generating function explicitly even when the graph contains an extremely large number of nodes. However, if the graph has been chosen at random, often no advantage can be derived from a topological characterization. The matrix method can then be applied, but computational complexity restricts the size of graphs which can be analyzed. (Contractor's abstract, in part)

894

Harvard U. Cruft Lab., Cambridge, Mass.

JOINT OPTIMIZATION OF TRANSMITTER AND RE-CEIVER IN PULSE AMPLITUDE MODULATION, by D. W. Tufts and D. A. Shnidman. July 14, 1964 [22]p. incl. diagrs. refs. (Technical rept. no. 444) (AFOSR-64-2216) (Nonr-186616) AD 607094　　　　Unclassified

Jointly optimum transmitted waveforms and linear time-varying receivers are specified for Pulse Amplitude Modulation systems which are subject to two kinds of interference, noise and intersymbol interference. The mean-square error in the receiver's reproduction of the random message sequence is used as the performance criterion. The joint optimization is carried out in detail for the case of signaling through a noisy RC filter. Special emphasis is placed on the

empirical exploration of performance variations caused by different choices of the message correlation matrix. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

NONLINEAR OPTICAL PROPERTIES OF SOLIDS, by P. S. Pershan. [1964] [8]p. incl. refs. (AFOSR-65-1393) (Nonr-186616)   Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb 11-15, 1963), New York, Columbia U. Press, v. 2: 1513-1520, 1964.

The nonlinear optical properties of solids are discussed. Theoretically, all effects can be described by adding to the linear Maxwell's equation a current element that is nonlinearly related to the E and H fields. The most general form of Maxwell's equations can be considered to be: $\nabla \times E = -(1/c) \partial B/\partial t$ $\nabla \times B = (1/c) \partial E/\partial t + (4\pi/c) J$ where J is a suitable macroscopic average of the microscope current elements. J can be expressed in terms of macroscopic electric dipole moment per unit volume, P, the magnetic dipole moment per unit volume, M, and the electric quadrupole moment per unit volume, Q: $J = \partial P/\partial t + c$ $\nabla \times M - \partial (\nabla . Q)/\partial t$. In this investiation the equations are discussed when J is not simply linearly related to either E or H.

896

Harvard U. Cruft Lab., Cambridge, Mass.

PARTIAL DIFFERENTIAL EQUATIONS FOR DENSITIES OF RANDOM PROCESSES, by T. Fine. May 4, 1964, 12p. (Technical rept. no. 445) (Nonr-186616) AD 604005   Unclassified

The Fokker-Planck-Kolmogorov (FPK) equation appears to be of wider applicability than is commonly realized. It is proved that the density functions for a wider class of vector random processes than just the Markov processes satisfy the FPK equations. Furthermore, an analogous derivation will yield a different partial differential equation applicable to multivariate densities for scalar random processes. The central technique is the evaluation of time derivatives of the characteristic function for the random variables of interest by two different methods; the comparison of the two different expressions for the time derivatives then yields the desired partial differential equations.

897

Harvard U. Cruft Lab., Cambridge, Mass.

STABILITY OF CERTAIN NONLINEAR DIFFERENTIAL EQUATIONS USING THE SECOND METHOD OF LIAPUNOV, by R. M. Goldwyn and K. S. Narendra. Mar. 18, 1963, 40p. (Technical rept. no. 403) (Nonr-186616) AD 409174; AD 410078   Unclassified

An approach is proposed for the construction of Liapunov functions for certain types of second and third-order nonlinear systems. If the system is described by a vector differential equation, a Liapunov function which ensures stability of the linear system for all values is called a common Liapunov function (CLF) in the given range. While it may prove difficult to determine such a CLF, a Liapunov function may be selected to ensure the stability of the linear system over the entire range of the parameters. Under certain conditions, this Liapunov function may be easily modified for use as a Liapunov function for a nonlinear system in which there are functions of the state variables. Using this approach, sufficient conditions are determined for the stability of a differential equation in terms of the bounds on certain functions.

898

Harvard U. Cruft Lab., Cambridge, Mass.

MULTI-PARAMETER SELF-OPTIMIZING SYSTEMS USING CORRELATION TECHNIQUES, by K. S. Narendra and L. E. McBride, Jr. June 5, 1963 [25]p. incl. diagrs. (Technical rept. no. 413) (AFOSR-5333) (Nonr-186632) AD 413402; AD 413511   Unclassified

A class of self-optimizing systems is described which continually alters its parameters to reduce a mean-square performance criterion. The change in each parameter is determined from an error gradient in parameter space computed by cross-correlation methods which are independent of signal spectra and require no test signal or parameter perturbation. Application of this technique to both open-loop and closed-loop systems are included, and it is shown that a combination of such self-optimizing systems is a possible solution to the adaptive control problem.

899

Harvard U. Cruft Lab., Cambridge, Mass.

THEORY OF THE TERMINATED INSULATED ANTENNA IN A CONDUCTING MEDIUM, by R. W. King. June 3, 1963 [50]p. incl. diagrs. refs. (Technical rept. no. 412) (AFOSR-5334) (Nonr-186632)   Unclassified

The general problem of the insulated antenna in an isotropic homogeneous medium of infinite extent is reviewed under the assumption that the medium is sufficiently conducting to permit the application of coaxial line theory. The currents and associated electromagnetic fields for the completely insulated antenna are obtained and the directional properties of the latter explained by comparison with a collinear array. An antenna in which only a central portion is insulated, while the ends are bare, is analyzed in terms of the theories of the insulated and bare antenna. This is done both for the case when the structure is driven by generators at the junctions of the bare and insulated sections and for the case when it is driven by means of an internal coaxial feeder in the manner of a sleeve dipole. Finally,

the center-driven insulated antenna with bare ends is investigated and its field is compared with that of the antenna driven at the junctions of the bare and insulated sections. (Contractor's abstract)

900

Harvard U. Cruft Lab., Cambridge, Mass.

A STUDY OF THE SLOT TRANSMISSION-LINE AND SLOT ANTENNA, PART 2. A COAXIAL AMPLITUDE-INSENSITIVE PHASE-DETECTION SYSTEM, by R. W. Burton. Jan. 20, 1963 [12]p. incl. diagrs. (Technical rept. no. 398) (AFOSR-64-0604) (Nonr-186632) AD 401892   Unclassified

A coaxial amplitude-insensitive phase-detection system is discussed in detail. The system employs the hybrid junction in a balanced detector configuration to render a null reading independent of the relative magnitude of both the reference and the unknown signals. A theoretical formulation, experimental results and evaluation of errors are presented.

901

Harvard U. Cruft Lab., Cambridge, Mass.

A STUDY OF CIRCULAR ARRAYS. 6. PLAN FOR PRACTICAL APPLICATION TO ARRAYS OF TWENTY OR FEWER ELEMENTS, by R. B. Mack and E. W. Mack. May 1, 1963, 1v. (Technical rept. no. 386) (AFOSR-64-0611) (Nonr-186632) AD 425554
                                                  Unclassified

The quasi-zeroth-order theory of linear antennas is presented in a form for engineering applications which avoids intricate mathematical details. The theory is packaged as a Fortran II program which computes radiation patterns, admittances, and current distributions of an array of dipoles or monopoles which are spaced so that they divide the circumference of a circle into an even number of parts. The user need only supply input data cards to the program.

902

Harvard U. Cruft Lab., Cambridge, Mass.

SCATTERING BY A PERFECTLY CONDUCTING CYLINDER IN A COMPRESSIBLE PLASMA, by S. R. Seshadri, I. L. Morris, and R. J. Mailloux. Apr. 15, 1963 [22]p. incl. diagrs. (Technical rept. no. 409) (AFOSR-64-0614) (Nonr-186632) AD 413340
                                                  Unclassified

The scattering of a plane electromagnetic (EM) or plasma (P) wave by a perfectly conducting and rigid circular cylinder immersed in an isotropic, compressible plasma is treated. Expressions for all the physical quantities of interest are obtained in the form of infinite series. For the case of a plane EM wave incidence, numerical results for the current induced on the surface of the cylinder, the total scattering cross sections and the back-scattering cross section,

are obtained as a function of $k_{eo}a$ for various values of the plasma frequency, where a is the radius of the cylinder and k_{eo} is the wave number of the EM wave in free space.

903

Harvard U. Cruft Lab., Cambridge, Mass.

TABLES OF THE GENERALIZED STIRLING NUMBERS OF THE FIRST KIND, by W. F. Pickard. Mar. 1, 1963 [11]p. incl. tables. (Technical rept. no. 404) (AFOSR-64-0616) (Nonr-186632) AD 405054
                                                  Unclassified

The generalized Stirling numbers of the first kind are defined, certain of their basic properties discussed, and tables given for the square grid $k = 0(1)10$ and $j = 0(1)10$ with $i = -10(1)10$. (Contractor's abstract)

904

Harvard U. Cruft Lab., Cambridge, Mass.

A STUDY OF ARRAYS OF DIPOLES IN A SEMI-INFINITE DISSIPATIVE MEDIUM, by K. Sivaprasad and R. W. P. King. Nov. 18, 1963 [20]p. incl. diagrs. (Technical rept. no. 391) (AFOSR-64-0702) (Nonr-186632)   Unclassified

Also published in IEEE Trans. Antennas and Propagation, v. AP-11: 240-256, May 1963.

The radial electric fields of horizontal dipoles in a semi-infinite dissipative medium are studied using the asymptotic expansion of a single dipole. An arrangement similar to an end-fire pattern of two broadside arrays in an infinite medium is used to investigate the possibility of obtaining a directed beam in the desired direction. After some important modifications, motivated by the nature of propagation in the medium, a suitable arrangement is found to give a directed beam.

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Harvard U. Cruft Lab., Cambridge, Mass.

THE ADMITTANCE OF BARE CIRCULAR LOOP ANTENNAS IN A DISSIPATIVE MEDIUM, by R. W. P. King, C. W. Harrison, Jr., and D. G. Tingley. Aug. 5, 1963 [30]p. incl. diagrs. tables. (Technical rept. no. 419) (AFOSR-64-1342) (Nonr-186632)
                                                  Unclassified

Also published in IEEE Trans. Antennas and Propagation, v. AP-12: 434-438, July 1964.

The normalized input admittance of thin bare circular loop antennas has been evaluated from the theory of T. T. Wu. Computations have been made for loops in air and in an infinite homogeneous isotropic dissipative medium. A comparison is also made with Storer's theory of the loop. Numerical results are given in the form of graphs for several wire sizes and for loops up to 2.5 wavelengths in circumference. The properties

of the medium are represented by the ratio α/β in the range from zero (perfect dielectric) to one (good conductor); α and β are the imaginary and real parts of the complex propagation constant $k = \beta - j\alpha = \omega\sqrt{\mu(\epsilon - j\sigma/\omega)}$ where μ is the permeability, ϵ the dielectric constant and σ the conductivity of the medium. (Contractor's abstract)

906

Harvard U. Cruft Lab., Cambridge, Mass.

THE IMPERFECTLY CONDUCTING CYLINDRICAL TRANSMITTING ANTENNA, by R. W. P. King and T. T. Wu. Mar. 27, 1964, 1v. incl. diagrs. refs. (Technical rept. no. 440) (AFOSR-64-1343) (Nonr-186632) AD 601643   Unclassified

The properties of a cylindrical antenna with a continuous ohmic resistance along its length are of interest in the design of certain types of directive broad-bond antennas. Conventionally, the contribution by ohmic resistance to the distribution of current and the impedance is contained in a particular integral that is either ignored or treated as a higher order correction to formulas derived for perfectly conducting antennas. An alternative and more useful form has been developed in which the integral equation for the current is rearranged to permit the introduction of a complex propagation constant k. An approximate solution of this equation is then obtained in terms of the three trigonometric functions, $\sin(h-|z|)\cos kz - \cos kh$ and $\cos 1/2\, k0z - \cos 1/2\, k0h$ where k0 is the free-space wave number. Expressions are derived for the coefficients of these functions and for k. Explicit formulas are given for the distribution of current and the admittance.

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Harvard U. Cruft Lab., Cambridge, Mass.

CURRENTS, CHARGES, AND NEAR FIELDS OF CYLINDRICAL RECEIVING ANTENNAS, by R. W. P. King. Aug. 19, 1964 [26]p. incl. diagr. (Technical rept. no. 453) (AFOSR-64-2453) (Nonr-166632) AD 608262   Unclassified

The cylindrical center-loaded receiving antenna in an incident linearly polarized plane-wave field was analyzed. Approximate expressions were obtained for the distributions of current and charge that involve three trigonometric terms with suitably defined coefficients. These are much more accurate than the usual zero-order currents and charges, and much simpler than higher-order iterated solutions. The complex effective length was determined. Formulas were also obtained for the reradiated or scattered field very near the antenna in the important special case when the antenna lies in the plane of the incident wave front. These are useful in certain applications that involve radio frequency hazards.

908

Harvard U. Cruft Lab., Cambridge, Mass.

RADIATION FROM AN ELECTROMAGNETIC SOURCE IN A HALF-SPACE OF COMPRESSIBLE PLASMA-SURFACE WAVES, by S. R. Seshadri. Mar. 5, 1963, 21p. (Technical rept. no. 396) (Nonr-186632) AD 409175; AD 410077   Unclassified

The radiation characteristics of a line source of magnetic current are studied for the case in which the source is situated in a half-space of isotropic, compressible plasma which is bounded on one side by a perfectly conducting, rigid plane screen. In addition to the electromagnetic and plasma space waves, the line source excites a boundary wave. This boundary wave is a coupled wave. It has associated with it both a magnetic field component and the pressure term. This is in contrast to the space waves which can be decomposed into an electromagnetic (EM) mode with no pressure term and a plasma (P) mode with no magnetic field associated with it. The characteristics of this boundary wave are evaluated. The boundary wave propagates for all frequencies and the power carried by the boundary wave becomes smaller as the frequency is increased.

909

Harvard U. Cruft Lab., Cambridge, Mass.

A REEXAMINATION OF SURFACE CONDUCTIVITY, by W. F. Pickard. Sept. 27, 1963, 20p. (Technical rept. no. 408) (Nonr-166632) AD 425562   Unclassified

The problem of calculating the surface conductivity at an electrolyte-solid interface is reconsidered. Some of the limitations of the existing definitions and theoretical approaches are pointed out, and the problem is reworked to include the effects of non-zero space charge and ion concentration on the conductivity. An approximate method is presented for calculating the mobility of an ion in a non-neutral environment. These considerations are illustrated by the problem of the local conductivity in a cylindrical pipe and the local conductivity near a half-plane.

910

Harvard U. Cruft Lab., Cambridge, Mass.

SCATTERING OF UNIDIRECTIONAL SURFACE WAVES, by S. R. Seshadri. Feb. 15, 1963, 20p. incl. illus. (Technical rept. no. 402) (Nonr-166632) AD 401694   Unclassified

A perfectly conducting plane screen embedded in a gyrotropic medium is shown to be able to support a unidirectional surface wave. Such a surface wave is assumed to be incident on the top of a semi-infinite screen. At the edge, the incident power is converted partly into a reflected surface wave which travels on the bottom of the screen and partly into a space wave. The angular distribution of the radiated energy as well

as the power-reflection and the power-transmission coefficients are evaluated. Total reflection is shown to occur for a certain band of frequencies.

911

Harvard U. Cruft Lab., Cambridge, Mass.

SOLVING THE EQUATIONS OF UNIFORM FLOW, by W. F. Pickard. Jan. 15, 1963, 23p. incl. illus. (Technical rept. no. 400) (Nonr-1d6632) AD 401893
Unclassified

The problem of solving the equation for uniform flow in an open channel is reduced to that of evaluating three simple integrals. Practical methods of computing these integrals are discussed.

912

Harvard U. Cruft Lab., Cambridge, Mass.

TABLES FOR THE STEP-BY-STEP INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS OF THE FIRST ORDER, by W. F. Pickard. Mar. 25, 1963, 7p. (Technical rept. no. 406) (Nonr-186632) AD 409173; AD 410076
Unclassified

A study is made of the step-by-step integration of ordinary differential equations of the first order by means of formulas obtained from the Gregory-Newton backward interpolating formula. Tables of relevant constants are presented.

913

Harvard U. Dept. of Chemistry, Cambridge, Mass.

STRUCTURES OF BIOLOGICALLY ACTIVE MOLECULES, by W. N. Lipscomb. Final rept. Nov. 30, 1963, 6p. (AFOSR-64-1110) (AF 49(638)809) AD 601692
Unclassified

A bibliography of 10 references is given on the molecular and crystal structure of some biologically active molecules.

914

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON THE LOCATION OF THE ZEROS OF SOME INFRAPOLYNOMIALS WITH PRESCRIBED COEFFICIENTS, by J. L. Walsh and O. Shisha. [1964] [7]p. incl. refs. (AFOSR-65-0350) (AF 49(638)574) AD 611909
Unclassified

Also published in Pacific Jour. Math., v. 14: 1103-1109, 1964.

Some nth infrapolynomials are considered on some special sets S with respect to simple n-sequences. The location of real and non-real zeros of the infrapolynomials A(z) is established for cases when S is con-

tained in a disc and a finite interval and A(z) is real and non-real. The results are applied to some special cases of infrapolynomials. From the results on infrapolynomials, Marden's theorem that the number of zeros of a given complex polynomial over a set S at which S subtends and angle $< \pi/(p+1)$ is $\leq p$ is derived.

915

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON CERTAIN ALGEBRAS OF ANALYTIC FUNCTIONS, by K. V. R. Rao. [1964] [5]p. (AFOSR-64-2280) (AF AFOSR-63-393) AD 452386
Unclassified

Also published in Michigan Math. Jour., v. 11: 231-235, 1964.

Given a Riemann surface W, and the set of all analytic functions of bounded characteristic on W, together with the constants. If W1 and W2 are hyperbolic plane regions and the algebras are isomorphic, then W1 and W2 are conformally equivalent. The present note extends this result to the case where W1 and W2 are hyperbolic Riemann surfaces of arbitrary finite genus. To contrast the result with known characterizations of conformal structure in terms of bounded analytic functions, it is shown that a hyperbolic Riemann surface of finite genus may not admit nonconstant bounded analytic functions. The complex-valued homomorphisms of a general class of algebras is determined. Homomorphisms of certain algebras of rational functions are discussed. The conformal structure of a hyperbolic surface W of finite genus is determined by the set of analytic functions of bounded characteristic on W. The general class of algebras considered is discussed.

916

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

THE CONVERGENCE OF SEQUENCES OF RATIONAL FUNCTIONS OF BEST APPROXIMATION, by J. L. Walsh. [1964] [13]r. (AFOSR-64-2365) (AF AFOSR-63-393) AD 452356
Unclassified

Also published in Math. Ann., v. 155: 252-264, 1964.

The present writer has constructed a table of rational functions of best approximation, where the degrees of numerator and denominator are prescribed, and has studied especially the question of possibility of approximation. The purpose of the present paper is to study sequences of that table (clearly analogous to the table of Pade) especially with reference to degree of approximation and to overconvergence of various subsequences. Consideration is given the degree of convergence, some preliminary results, overconvergence as a consequence of a certain degree of convergence, regions and degree of convergence of sequences of best approximation according to various norms, and exact geometric degrees of convergence. The present results, in their study of regions of convergence and limit points of poles of the approximating sequences, are qualitatively similar to older results on the Pade table due to Montessus de Ballore.

917

Harvard U. Dept. of Mathematics, Cambridge. Mass.

SURPLUS FREE POLES OF APPROXIMATING RATIONAL FUNCTIONS, by J. L. Walsh. [1964] [6]p. (AFOSR-64-2489) (AF AFOSR-63-393) AD 453797
Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 52: 896-901, Oct. 1964.

Under broad conditions, rational functions which approximate on a point set E of the z plane to a function analytic on E and meromorphic in a region containing E have free poles which the respective poles of $f(z)$. However, if the rational functions have an excess of free poles, the question arises as to the asymptotic behavior of those poles, and the possible effect on degree of convergence on E and elsewhere if those poles are suppressed. The present note makes a contribution to this study, in both general theory and by specific examples.

918

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON THE LOCATION OF THE ZEROS OF A POLYNOMIAL WHOSE CENTER OF GRAVITY IS GIVEN, by Z. Rubinstein and J. L. Walsh. [1964] [14]p. (AFOSR-64-2490) (AF AFOSR-63-393) AD 454016
Unclassified

Also published in Jour. D'Anal. Math., v. 12: 129-142, 1964.

Proof of two lemmas involving centers of gravity of zeros has indicated various applications in the geometry of zeros. The object of the present study is to indicate further applications in the same field.

919

[Harvard U. Dept. of Mathematics, Cambridge Mass.]

KLEINIAN GROUPS, by L. V. Ahlfors. [1964] [7]p. (AFOSR-65-0092) (AF AFOSR-63-393) AD 455631
Unclassified

Presented at Ann. Sci. Conf. of Belfer Graduate School of Science, Yeshiva U., Sept. 24, 1962.

Also published in Scripta Math., v. 27: 97-103, [1964].

In Poincaré's terminology, arbitrary discontinuous groups of linear transformations are called Kleinian groups, while the groups with an invariant circle are said to be Fuchsian. This report proves 2 theorems concerning the dimensions of spaces of quadratic differentials that are associated naturally with a given Kleinian group: (1) $\dim Q(\Delta') \leq \dim Q(\Delta_0)$. Let Δ' be the complement of Δ_0, or, more generally, any union of orbits distinct from Δ_0. Assume outright that Δ'/Γ is likewise compact. (2) If the quadratic differentials

are restricted by $|\varphi| = 0(_p-1)$ and by $\int_{\Delta'\Gamma} |\varphi| \, dx\, dy < \infty$ then $\dim Q(\Delta') \leq \dim Q(\Delta_0)$ whenever Δ_0 is simply connected.

920

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

THE QUANTUM THEORY OF OPTICAL COHERENCE, by R. J. Glauber. [1963] [11]p. incl. refs. (AFOSR-J917) (AF 49(638)589) AD 416564 Unclassified

Also published in Phys. Rev., v. 130: 2529-2539, June 15, 1963.

A fully coherent field is defined as one whose correlation functions satisfy an infinite succession of stated conditions. Various orders of incomplete coherence are distinguished, according to the number of coherence conditions actually satisfied. It is noted that the fields historically described as coherent in optics have only first-order coherence. On the other hand, the existence, in principle, of fields coherent to all orders is shown both in quantum theory and classical theory. The methods used in these discussions apply to fields of arbitrary time dependence. It is shown, as a result, that coherence does not require monochromaticity. Coherent fields can be generated with arbitrary spectra.

921

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

ON PARTIALLY CONSERVED CURRENTS, by S. Ccleman. [1963] [9]p. (AFOSR-J1608) (AF 49(638)589) AD 427622 Unclassified

Also published in Ann. Phys., v. 24: 37-45, Oct. 1963.

It is observed that the hypothesis of partially conserved leptonic weak interaction currents, which has been proposed by several authors, implies that the fundamental meson-baryon interaction be invariant under a certain group constructed from these currents. The only candidate for this group consistent with experiment and that does not require the introduction of an exorbitant number of spinless mesons is the eight-dimensional rotation group. The associated meson-baryon coupling is one first proposed by Gursey. This group does not seem to have any connection with the approximate symmetries of strong interactions; thus we reject the notion of partially conserved currents.

922

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

COHERENT AND INCOHERENT STATES OF THE RADIATION FIELD, by R. J. Glauber. [1963] [23]p. incl. refs. (AFOSR-64-0520) (AF 49(638)589) AD 434418
Unclassified

Also published in Phys. Rev., v. 131: 2766-2788, Sept. 15, 1963.

Methods are developed for discussing photon statistics of arbitrary radiation fields in fully quantum-mechanical terms. In order to keep the classical limit of quantum electrodynamics plainly in view, extensive use is made of the coherent states of the field. These states, which reduce the field correlation functions to factorized forms, are shown to offer a convenient basis for the description of fields of all types. Although they are not orthogonal to one another, the coherent states form a complete set. Any quantum state of the field may be expanded in terms of them in a unique way. Expansions are also developed for arbitrary operators in terms of products of the coherent state vectors. These expansions are discussed as a general method of representing the density operator for the field. A particular form is exhibited for the density operator which makes it possible to carry out many quantum-mechanical calculations by methods resembling those of classical theory.

923

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

A NINTH BARYON, by J. Schwinger. [1964] [3]p. (AFOSR-64-1241) (AF 49(638)589) AD 442853
Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 237-239, Mar. 2, 1964.

This note reports some results obtained by elementary calculations from a new field theory of matter. The theory is an attempt to explore the otherwise inaccessible substratum of the nuclear world with the aid of an analogy between nucleonic charge N and electrical charge Q. Fundamental fields and physical particles are presumed to be in direct correspondence for the leptons. The dynamics of the leptonic world is described by the vector electromagnetic field A which is coupled to the exactly conserved charge Q, and by the vector field Z which interacts with exchanges of electrical charge and is responsible for the phenomenological weak interactions.

924

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

DEPARTURES FROM THE EIGHTFOLD WAY: THEORY OF STRONG INTERACTION SYMMETRY BREAKDOWN, by S. Coleman and S. L. Glashow. [1964] [11]p. (AFOSR-64-1754) (AF 49(638)589) AD 449260
Unclassified

Also published in Phys. Rev., v. 134: B671-B681, May 11, 1964.

Three kinds of departure from exact unitary symmetry are considered: medium-strong interactions which leave only isospin and hypercharge as good symmetries, electromagnetism, and weak interactions. The existence of an octet of scalar mesons that give the possibility of symmetry-breaking tadpole diagrams are postulated.

925

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

MIXING OF ELEMENTARY PARTICLES, by S. Coleman and H. J. Schnitzer. [1964] [10]p. (AFOSR-64-1755) (AF 49(638)589) AD 449095
Unclassified

Also published in Phys. Rev., v. 134: B863-B872, May 25, 1964.

Particle mixing is studied in a field-theoretic context, as a further approximation to the pole approximation. Although particle mixing is well suited for treating spinless particles, another approximation, also a further approximation to the pole approximation, called vector mixing, is better for treating particles of spin one. Vector mixing is applied to several processes involving the mixing of the particles by the interaction that breaks unitary symmetry.

926

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

FIELD THEORY OF MATTER, by J. Schwinger. [1964] [15]p. (AFOSR-64-2048) (AF 49(638)589) AD 452517
Unclassified

Also published in Phys. Rev., v. 135: B816-B830, Aug. 10, 1964.

A speculative field theory of matter is developed. Simple computational methods are used in a preliminary survey of its consequences. The theory exploits the known properties of leptons by means of a principle of symmetry between electrical and nucleonic charge. There are fundamental fields with spins 0, 1/2, 1. The spinless field is neutral. Spin 1/2 and 1 fields can carry both electrical and nucleonic charge. The multiplicity of any nonzero charge is 3. Explicit dynamical mechanisms for the breakdown of unitary symmetry and for the muon-electron mass difference are given. A more general view of lepton properties is proposed. Mass relations for baryon and meson multiplets are derived, together with approximate couplings among the multiplets.

927

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

MASS FORMULAS AND MASS INEQUALITIES FOR REDUCIBLE UNITARY MULTIPLETS, by S. Coleman, S. L. Glashow, and D. J. Kleitman. [1964] [4]p. (AFOSR-64-2049) (AF 49(638)589) AD 452518
Unclassified

Also published in Phys. Rev., v. 135: B779-B782, Aug. 10, 1964.

For irreducible unitary multiplets of elementary particles, the Gell-Mann-Okubo mass formula is equivalent to the assertion that the effective masses transform under SU(3) like a superposition of a singlet and the

neutral member of an octet. We consider the implications of this assertion for reducible unitary multiplets. We find weaker mass formulas, which allow for the mixing between different irreducible components; moreover, we find that certain inequalities must be satisfie' Specific examples are described. (Contractor's abstract)

928

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

THE CLEBSCH-GORDON SERIES FOR SU(3), by S. Coleman. [1964] [2]p. (AFOSR-64-2514) (AF 49(638)-589) AD 453819   Unclassified

Also published in Jour. Math. Phys., v. 5: 1343-1344, Sept. 1964.

A method is explained for the calculation of the reduction of direct products of irreducible representations of SU(3). The method is believed to be simpler and more efficient than the usual algorithms.

929

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

FIELD THEORY OF MATTER. II, by J. Schwinger. [1964] [4]p. (AFOSR-65-0465) (AF 49(638)1380) AD 453822   Unclassified

Also published in Phys. Rev., v. 136: B1821-B1824, Dec. 21, 1964.

A qualitative dynamical interpretation is given for observed regularities on non-leptonic phenomena in strong, electromagnetic, and weak interactions. These regularities are presented in the framework of a recently proposed field theory of matter (Phys. Rev. Ltrs., v. 12: 237, 1964 and Phys. Rev., v. 135: B816, 1964).

930

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

DEPARTURES FROM THE EIGHTFOLD WAY. II. BARYON ELECTROMAGNETIC MASSES, by S. Coleman and H. J. Schnitzer. [1964] [4]p. (AFOSR-64-2550) (AF 49(638)1380) AD 453967   Unclassified

Also published in Phys. Rev., v. 136: B223-B226, Oct. 12, 1964.

The leading nontadpole contributions to the electromagnetic mass splittings of the baryons are calculated. Best fits to experiment are used for the nucleon form factors; the strange baryon form factors are obtained from these by unitary symmetry. Account is taken of the breakdown of unitary symmetry by using experimental masses in intermediate states and by including the effects of theta-omega mixing. These calculations and the assumption of tadpole dominance are used to fit the six mass splittings of baryons and pseudo-

scalar mesons with one free parameter. All of the splittings are in good agreement with experiment except for the kaon splitting, which has the right sign but only 2/3 of the proper magnitude.

931

Harvard U. Medical School, Boston, Mass.

RECEPTIVE FIELDS OF CELLS IN STRIATE COR-TEX OF VERY YOUNG, VISUALLY INEXPERIENCED KITTENS, by D. H. Hubel and T. N. Wiesel. [1963] [9]p. incl. diagrs. table, refs. (AFOSR-64-0543) (AF AFOSR-63-410) AD 436177   Unclassified

Also published in Jour. Neurophysiol., v. 26: 994-1002, Nov. 1963.

In a series of studies on the cat over the past 5 yr we have recorded from single cells in the striate cortex and mapped receptive fields using patterned retinal stimulation. The results suggest that connections between geniculate and striate cortex, and between cortical cells, must be highly specific. Indeed, cells in the striate cortex respond in such a characteristic way that departures from the normal adult physiology should be easily recognizable. In the present study we have made similar experiments in kittens ranging in age from 1-3 weeks. Our purpose was to learn the age at which cortical cells have normal adult-type receptive fields, and to find out whether such fields exist even in animals that have had no patterned visual stimulation.

932

Harvard U. Medical School, Boston, Mass.

EFFECTS OF VISUAL DEPRIVATION ON MORPHOL-OGY AND PHYSIOLOGY OF CELLS IN THE CAT'S LATERAL GENICULATE BODY, by T. N. Wiesel and D. H. Hubel. [1963] [16]p. incl. illus. diagrs. tables, refs. (AFOSR-64-0544) (AF AFOSR-63-410) AD 436176   Unclassified

Also published in Jour. Neurophysiol., v. 26: 978-993, Nov. 1963.

Kittens were subjected to deprivation of form and light in one eye, at various ages and for various periods. In kittens with the lids of one eye sutured from birth for 3 months, most geniculate cells with input from the deprived eye had normal receptive fields, with an on-center and an off-periphery, or the reverse. The normal process by which the peripheral suppression demonstrable in retinal ganglion cells is increased at the genicula level was observed. The over-all activity of layers fed by the deprived eye was, however, shed, and a few cells had sluggish responses and receptive fields with abnormally large centers. Marked histological changes were present in layers fed by the deprived eye. No obvious histological changes were found in the retinas, optic nerves, superior colliculi, or striate cortex. Lid closure for comparable periods in 2-month-old, visually experienced kittens produced

similar but less severe histological changes in the lateral geniculate bodies. No changes were seen in an adult cat visually deprived by lid suture of one eye for 3 months.

933

Harvard U. Medical School, Boston, Mass.

SINGLE CELL RESPONSES IN STRIATE CORTEX OF KITTENS DEPRIVED OF VISION IN ONE EYE, by T. N. Wiesel and D. H. Hubel. [1963] [15]p. incl. illus. diagrs. refs. (AFOSR-64-0545) (AF AFOSR-63-410) AD 436158   Unclassified

Also published in Jour. Neurophysiol., v. 26: 1003-1017, Nov. 1963.

Recordings were made from striate cortex of kittens in which one eye had been deprived of vision either from birth or subsequently, and for various periods of time. Kittens deprived from birth for 2-3 mo showed profoundly defective vision in the deprived eye. Visual placing and following reactions were absent, and there was no hint of any ability to perceive form. Pupillary light reflexes were nevertheless normal. In kittens deprived from birth, the great majority of cortical cells were actively driven from the normal eye, with normal receptive fields. On the other hand, only 1 cell out of 84 was at all influenced by the deprived eye, and in that cell the receptive fields in the two eyes were adnormal. A few cells could not be driven from either eye. In one 2-month-old kitten monocularly deprived the corneal electroretinograms were normal in the two eyes.

934

Harvard U. [School of Dental Medicine] Cambridge, Mass.

HYPOTHALAMIC SECRETORY FACTOR FOR ADRENOCORTICOTROPIC HORMONE (SF-ACTH), by P. L. Munson. Final technical rept. Jan. 16, 1963, 8p. (AFOSR-49-2) (AF 49(638)740) AD 415479
        Unclassified

Research on the biological assay and purification of the hypothalamic secretory factor for ACTH (HSF-ACTH) has been described. Extracts of hypothalamic tissue are evaluated by testing for decrease in adrenal ascorbic acid (as an indicator of endogenous or exogenous ACTH) in three types of rats. Rats anesthetized with pentobarbital are used to estimate proper dose levels and to detect nonspecific stressful contaminants. Rats anesthetized with pentobarbital and treated with morphine, which do not respond to moderate stimulation by nonspecific substances, are used to estimate the amount of HSF-ACTH, but they also respond to ACTH. Hypophysectomized rats are used to estimate the amount of exogenous ACTH that may contaminate the HSF-ACTH preparations.

935

Hawaii U. [Dept. of Sociology] Honolulu.

PREDICTIVE MODEL FOR INTRA-GROUP NEGOTIATION, by O. J. Bartos. Final rept. Feb. 1, 1962 - June 31, 1964, 10p. incl. tables. (AFOSR-64-1440) (AF AFOSR-62-314) AD 604471   Unclassified

The study had the following objectives: (1) To test the assumption of maximization of expected utility. (2) To test the assumption that the impact of a speech depends only on which proposal it endorses. (3) To test the assumption that each negotiator speaks with a fixed probability. (4) To design a model that deals with negotiations in which majority (rather than unanimous) agreement is required. (5) To define optimal negotiation strategies. (6) To consider training expert negotiators.

936

Hawaii U. [Dept. of Sociology] Honolulu.

A MODEL OF NEGOTIATION AND THE RECENCY EFFECT, by O. J. Bartos. [1964] [16]p. incl. diagr. tables, refs. (AFOSR-65-0072) (AF AFOSR-62-314) AD 455740   Unclassified

Also published in Sociometry, v. 27: 311-326, Sept. 1964.

The paper describes a mathematical model of negotiation based on the von Neumann-Morgenstern theory of utility and on the Bush-Mosteller stochastic model of learning. It is shown that the model implies a "recency effect," i.e., that the later a proposal is introduced in a negotiation session, the more it influences the final decision. This implication is tested on data gathered from experimental sessions involving 35 five-man groups. It is shown that the so-called "mediator" behaves as predicted by the model: he is most likely to endorse the most recently endorsed proposals.

937

Hawaii U. [Dept. of Sociology] Honolulu.

CONCESSION-MAKING IN EXPERIMENTAL NEGOTIATIONS, by O. J. Bartos. Nov. 16, 1964, 42p. incl. diagrs. tables, refs. (AFOSR-65-0729) (AF AFOSR-62-314) AD 617798   Unclassified

Two seemingly contradictory hypotheses about concession-making were considered: (1) that concession-making occurs only as a result of the negotiator's failure (experienced when opponent lowers his offers); and (2) that it occurs only as a result of reciprocity (as a reaction to an opponent's concession-making). A total of 87 5-man experiments, bearing upon these hypotheses, were conducted. The findings were somewhat unexpected in that they suggested that an opponent's behavior determines a negotiator's behavior far less than one might expect: by and large, a negotiator's demands depended on his own previous demands. To the extent, however, to which an opponent's behavior was influential, the "reciprocity" hypothesis appeared

to be more nearly correct than the "failure" hypothesis. It was found, furthermore, that concession-making tended to be a rather bad strategy, that a negotiator making few concessions tended to receive higher pay-off than the negotiator who made many concessions. It was also shown that the deadline could play an important role in determining the final payoff, and that, were the time alloted for negotiation much shorter, concession-making might have been a more profitable strategy than it actually was.

938

Hebrew U., Jerusalem (Israel).

EFFECTS OF THREE LEVELS OF REALISTIC STRESS ON DIFFERENTIAL PHYSIOLOGICAL REACTIVITIES, by S. Kugelmass. Final rept. Aug. 19, 1963, 24p. (AFOSR-J1144) (AF EOAR-63-61) AD 423120
Unclassified

Using police trainees in controlled realistic lie detection stress situation it was found that (1) GSR results were essentially similar to those obtained in mild experimental situations and far superior to heart rate change results. (2) An analysis of GSR reactivity showed a strong relationship to basic conductance and is significantly related to ethnic origin.

939

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

STRICTLY ANTIPODAL SETS, by B. Grünbaum. [1963] [6]p. incl. diagrs. (AFOSR-J925) (AF EOAR-63-63) AD 416509
Unclassified

Also published in Israel Jour. Math., v. 1: 5-10, Mar. 1963.

A subset A of E^3 is called strictly antipodal provided that for every pair X_1, X_2 of points of A there is a pair H_1, H_2 of parallel supporting planes of such that $H_i \cap A = \{X_i\}$. The main result asserts that a strictly antipodal set has at most five points. This strengthens a recent result of Croft. (Contractor's abstract)

940

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

REAL INVERSION AND JUMP FORMULAE FOR THE LAPLACE TRANSFORM. PART I, by Z. Ditzian and A. Jakimovski. [1963] [20]p. (AFOSR-64-0213) (AF EOAR-63-63) AD 432573
Unclassified

Generalizations of the Laplace asymptotic method are obtained and real inversion formulae of the Post-Widder type for the Laplace transform are generalized.

941

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

A SIMPLE PROOF OF A THEOREM OF MOTZKIN, by B. Grünbaum. [1964] [3]p. incl. diagrs. (AFOSR-65-1032) (AF EOAR-63-63) AD 619762
Unclassified

Also published in Koninkl. Nederl. Akad. Wetensch. Proc., Indag. Math., Ser. A, v. 67: 382-384, 1964.

A new proof is presented of T. S. Motzkin's theorem that a 3-dimensional convex polytope, with each vertex and face incident to a number of edges which is a multiple of 3, has an even number of edges. The proof consists of two theorems: the first dealing with a special case of Motzkin's theorem in which each vertex has valence 3, and the second concerning the parity of faces and connected components of a 3-valent graph.

942

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

ADDITION AND DECOMPOSITION OF CONVEX POLY-TOPES, by W. J. Firey and B. Grünbaum. [1964] [10]p. incl. refs. (AFOSR-65-1033) (AF EOAR-63-63) AD 619761
Unclassified

Also published in Israel Jour. Math., v. 2: 91-100, June 1964.

This paper presents a new addition for convex polytopes, which is a modification of a process presented earlier by H. Minkowski and which may be considered as a special case of the addition of generalized curvature functions. The new addition is such that the known results on planar decomposition in terms of vector addition have valid analogs in higher dimensions.

943

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

SELF-CIRCUMFERENCE OF CONVEX SETS, by B. Grünbaum. [1964] [3]p. incl. diagrs. (AFOSR-65-1401) (AF EOAR-63-63) AD 622441
Unclassified

Also published in Colloq. Math., v. 13: 55-57, 1964.

Let K be a convex body in the plane, and let $z \in$ int K. A norm is defined by the Minkowski functional $\|x\|_{K,z} = \inf \{\lambda > 0 | x-z \in \lambda(K-z)\}$. For an oriented closed curve C let the length of C in the metric derived from $\| \|_{K,z}$ be denoted by $L_{K,z}(C)$; the self-circumference of K is $L(K) = \inf \{L_{K,z}(bdK) | z \in$ int K$\}$, where bdK is taken in either of the two possible orientations. In this investigation Gołab's conjecture that $L(K) \leq 9$ for every convex body K in the plane is proved. The proof is dependent on the lemma that for every planar convex body K there exists an affine-regular hexagon circumscribed about K. For such a hexagon H with center at origin, it is proved that $L_{K,O}(bdH) \leq 9$.

944

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

A COUNTEREXAMPLE TO A PROBLEM OF SZ.-NAGY, by S. R. Foguel. [1964] [3]p. (AFOSR-65-1403) (AF FOAR-65-27) AD 621264 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 788-790, Oct. 1964.

An operator in a Hilbert space with uniformly bounded powers is constructed which is not similar to a contraction. (An operator P is a contraction if $\|P\| \leq 1$.) This furnishes a negative answer to a surmise made by Sz.-Nagy in a former paper that if T is an operator in euclidean space, not invertible, such that its iterates have a common bound, T is similar to a contraction.

945

Hebrew U. Dept. of Physics, Jerusalem (Israel).

SIMULTANEOUS DIFFRACTION IN ANTHRACENE, by L. Cohen, B. S. Fraenkel, and Z. H. Kalman. Jan. 1963, 8p. incl. diagrs. tables. (Technical rept. no. 2) (AFOSR-4732) (AF 61(052)222) AD 407669
Unclassified

Also published in Acta Cryst., v. 16: 1192-1195 Dec. 1963.

An analytical method is used to index the (100) simultaneous diffractions in (monoclinic) anthracene. The expected pattern of diffractions is calculated and compared with experimental observations. The computations are amenable to desk calculators. Simultaneous diffractions from 23 different pairs of planes are identified and tabulated for anthracene using copper $K \alpha$ radiation.

946

Hebrew U. Dept. of Physics, Jerusalem (Israel).

HYPERFINE INTERACTIONS IN THE GROUND STATE AND 21.7-KEV STATE OF Eu^{151} IN EUROPIUM IRON GARNET, by I. Nowik, and S. Ofer. [1963] 23p. incl. diagrs. tables, refs. (Technical note no. 8) (AFOSR-5061) (AF 61(052)347) AD 414125 Unclassified

Also published in Phys. Rev., v. 123: 241-245, Oct. 1963.

The hyperfine interaction of the ground state and 21.7 kev state of Eu^{151} in europium iron garnet have been measured at 300, 81 and 20°K using the technique of Mossbauer absorption. Values of (335 ± 50) kOe, (570 ± 35) kOe and (670 ± 100) kOe were found for effective magnetic fields acting on the Eu nuclei in europium iron garnet at the temperatures of 300, 81 and 20°K respectively. These values are in agreement with theoretical calculations of the non-diagonal matrix elements associated with the admixture of

states produced by the exchange interaction. The value of the quadrupole interaction of the ground state of Eu^{151} in europium iron garnet was found to be $(-240 [100]mc/sec$ at 81°K. The results yield an assignment of a spin of 7/2 for the 21.7 kev level and a value of $\mu = (2.54 \pm 0.15)$ n m for the magnetic moment of this level.

947

Hebrew U. Dept. of Physics, Jerusalem (Israel).

EFFECTIVE MAGNETIC FIELD AND GRADIENT OF ELECTRIC FIELD ACTING ON THE NUCLEUS OF Eu IN EUROPIUM IRON GARNET, by G. Gilat and I. Nowik. [1963] [4]p. incl. diagrs. refs. (AFOSR-J1578) (AF 61(052)347) AD 427596 Unclassified

Also published in Phys. Rev., v. 130: 1361-1364, May 15, 1963.

The internal effective magnetic field (H_{eff}) and the electric field gradient acting on europium nuclei in europium iron garnet has been calculated. The nondiagonal matrix elements connected with the admixture of states produced by the exchange interaction give the main contribution to these fields. The temperature dependence of these fields is compared with the dependence of the magnetic moment of the ion as calculated by Wolf and Van Vleck. The effective magnetic field at 0°K turns out to be 7×10^5Oe, whereas, the electric field gradient at 0°K is eq/h = -555 mc/sec per b. In an Appendix the paramagnetic correction for the internal magnetic field acting on the nucleus of Eu in the presence of an external magnetic field is also calculated as a function of temperature. At room temperature $H_{int} = 1.54 H_0$. (Contractor's abstract)

948

Hebrew U. Dept. of Physics, Jerusalem (Israel).

A STUDY OF CONDUCTION ELECTRON POLARISATION IN FERROMAGNETIC GADOLINIUM USING PERTURBATION OF $\gamma - \gamma$ CORRELATIONS, by S. G. Cohen, N. Kaplan and others. [1963] [2]p. incl. diagr. table, refs. (AFOSR-64-0755) (AF 61(052)347) AD 436505 Unclassified

Also published in Phys. Ltrs., v. 7: 91-92, Nov. 1, 1963.

In this work, lutecium nuclei within trivalent lutecium ions, situated as dilute impurities in ferromagnetic gadolinium, have been used as a probe to estimate the local polarization of the conduction electrons. The sign and magnitude of the magnetic field acting on these lutecium nuclei have been obtained, using the technique of measuring the perturbation of the angular correlation of a cascade of nuclear γ-rays.

949

Hebrew U. Lept. of Physics, Jerusalem (Israel).

ELECTRON DENSITY IONIZATION RATE AND AP-
PROACH TO THERMAL EQUILIBRIUM BEHIND SHOCK
WAVES BY MEANS OF MICROWAVE TECHNIQUES, by
W. Low. Final scientific rept. Oct. 1964, 24p. incl.
refs. (AFOSR-65-1138) (AF 61(052)401) AD 619093
Unclassified

The following subjects were investigated: (1) Improve-
ment in the microwave diagnostics of shock waves;
(2) Time dependence and shape of microwave attenua-
tion in shocks of air at pressures of 1 and 5 mm Hg;
(3) Measurements of the peak microwave attenuation
of shock waves in argon and neon; (4) The effect of
constrictions and taper sections on the shock speed
and on microwave attenuation; (5) Experiments with
an electrical discharge shock tube; (6) Construction of
a 4mm Fahry-Perot interferometer; and (7) Testing
a 4mm carcinotron. Three papers were published as
a result of this work.

950

Hebrew U. [Dept. of Physics] Jerusalem (Israel).

MICROWAVE MEASUREMENTS ON SHOCK WAVES
IN AIR, by M. Dvir and W. Low. [1963] [5]p. incl.
illus. diagrs. refs. (AFOSR-65-1237) (AF 61(052)-
401) AD 621345 Unclassified

Also published in Proc. Sixth Internat'l. Conf. on Ion-
ization Phenomena in Gases, Paris (France) (July 8-
13, 1963), v. 4: 325-329 [1963].

The microwave attenuation by shock waves in air is in-
vestigated in the Mach no. range of 8-12 and at pres-
sures of 1-5 mm Hg. It is shown that an analysis of
the time dependence of the attenuation yields important
information regarding (a) the maximum electron-den-
sity, (b) the huild-up of the electron density and the
heginning of the shock, (c) the electron density near the
contact surface, and (d) the length of the heated slug
section. An investigation has also been made of the
effect of transitions from a larger diameter shock tube
to a smaller tube on the maximum microwave attenua-
tion, on its time dependence, and on the Mach no. In
particular, the effect of shorter and larger taper sec-
tions is studied, as well as abrupt transitions for vari-
ous Mach numbers and initial pressures.

951

Hebrew U. Dept. of Physics, Jerusalem (Israel).

MICROWAVE ATTENUATION BY SHOCKED HEATED
AIR, by M. Dvir and W. Low. [1964] [9]p. incl. illus.
diagrs. refs. (AFOSR-65-1238) (AF 61(052)401)
AD 621559 Unclassified

Also published in Phys. Fluids, v. 7: 578-586,
Apr. 1964.

The microwave attenuation of air in Mach range 8-12

is investigated at initial pressures of 5 mm Hg. It is
shown (a) that the experimental peak attenuation is
larger than given hy conventional theory; and (b) that
the time dependence of the attenuation curve gives im-
portant information regarding the huild-up of the ioniza-
tion as a function of time, the contact surface and the
zone hehind it. It is found that the microwave attenua-
tion rises approximately linearly as a function of time
to its peak value. The testing time is shorter than that
predicted from ideal shock theory but sufficient to es-
tablish quilibrium. The electron density changes
abruptly upon arrival of the driver gas. However, an
appreciable electron density exists over a large region
hehind the contact surface indicating strong interface
mixing. It is also shown that the nature of the surface
of the shock tube influences the peak attenuation and
the time dependence of this attenuation.

952

Hebrew U. Dept. of Physics, Jerusalem (Israel).

RESEARCH IN SOFT X-RAY AND FAR ULTRA-VIOLET
SPECTROSCOPY, hy E. Alexander and B. S. Fraenkel.
Annual technical rept. Jan. 31, 1963, 12p. (AFOSR-
4595) (AF EOAR-62-33) AD 401030 Unclassified

The following research was carried out: Building and
adjustment of instruments for research in the vacuum
ultra-violet; Investigation into spectra obtained by the
sliding spark method from the electrodes and from the
insulator; High spectra of Cu in the 100-200 A region,
and the dependence of their intensities on electrical pa-
rameters; Determination of W(74) lines in the 100-200
A region; and Investigation into spectra of light ele-
ments in the 100-200 A region. A method for obtaining
absorption measurements of gases in the far ultra-
violet has been developed. (Contractor's ahstract)

953

Hebrew U. Dept. of Physics, Jerusalem (Israel).

ORTHORHOMBIC ELECTRON SPIN RESONANCE
SPECTRUM OF U^{3+} IN CaF_2, by E. Mahlab, V.
Volterra and others. [1963] [3]p. incl. diagrs.
(AFOSR-J1581) (AF EOAR-63-64) AD 427598
Unclassified

Also published in Phys. Rev., v. 131: 920-922, Aug. 1,
1963.

An orthorhombic spectrum of U^{3+} in CaF_2 was meas-
ured. The orthorhombic X, Y axes are found to lie in
the (110) plane and the Z axis perpendicular to these
axes. The X axes are at $\pm(19 \pm 1)°$ with the $[1\bar{1}0]$ di-
rection. There are, in general, twelve inequivalent
magnetic sites. The g factors corresponding to one set
of axes are $g_x = 1.38 \pm 0.01$, $g_y = 2.85 \pm 0.02$, and
$g_z = 2.94 \pm 0.01$. Various models explaining this
spectrum are discussed. The most likely model is
that of an interstitial F^- in the second-nearest neigh-
hor position. (Contractor's ahstract)

954

Hebrew U. Dept. of Physics, Jerusalem (Israel).

EVIDENCE FOR TETRAGONAL DISTORTIONS FROM
E. S. R. SPECTRA IN CRYSTALS OF CALCIUM OX-
IDE, by W. Low and J. T. Suss. [1964] [6]p. incl.
diagr. table, refs. (AFOSR-64-0756) (AF EOAR-63-
64) AD 438240   Unclassified

Also published in Solid State Commun., v. 2: 1-6, 1964.

The line width of the cubic e. s. r. spectra of iron group
elements in single crystals of calcium oxide depends
on the orientation of the symmetry axis with respect
to the external magnetic field. It is found that the
narrowest line width is along the (111) direction and
the widest line along the (100) direction.

955

Hebrew U. Dept. of Physics, Jerusalem (Israel).

THE GROUND STATES AND RELATIVE STARK
SPLITTINGS OF SOME TRIVALENT RARE EARTH
IONS IN THE CUBIC CRYSTAL FIELD OF CALCIUM
FLUORIDE, by U. Ranon. Mar. 1964, 22p. incl.
diagrs. refs. (Rept. no. IA-697) (AFOSR-65-2305)
(AF EOAR-63-64) AD 628401   Unclassified

The ratios B_4/B_6 of the cubic crystal field parameters
are calculated from electron spin resonance on CaF_2;
Nd^{3+} and CaF_2;Dy^{3+}, and the results are used to show
that the ratio A_4/A_6 is not constant, as required by
the point charge model. A linear expression of A_4/A_6
as a function of Z is constructed from the available
data. The integrals $<r^4>$ and $<r^6>$ of Freeman and
Watson are used in deducing B_4/B_6 for the trivalent
rare earth ions. Eigenfunctions and eigenvalues of
Lea, Leask and Wolf are employed in deducing the
ground states and relative Stark splittings of the rare
earth ions. Optical spectra are discussed.

956

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE OF Yb^{3+} IN $CaWC_4$, by
U. Ranon and V. Volterra. [1964] [3]p. (AFOSR-65-
2544) (AF EOAR-63-64) AD 626363   Unclassified

Also published in Phys. Rev., v. 134: A1463-A1465,
June 15, 1964.

Paramagnetic resonance of Yb(3+) was observed in
single crystals of CaWO4 at 20°K and 3 cm. A tetra-
gonal as well as two rhombic spectra were found.
The spectra arise from Yb(3+) ions at Ca(2+) sites
and the rhombic symmetry is caused by charge com-
pensation at next-nearest-neighbor Ca(2+) sites. The
possibility of W(6+) substitution is discussed.

957

Hebrew U. Dept. of Physics, Jerusalem (Israel).

THE PREPARATION OF SOURCES OF Co^{57} FOR
MÖSSBAUER EXPERIMENTS HAVING NARROW UN-
SPLIT EMISSION LINES, by A. Mustachi. [1964] [2]p.
incl. diagr. refs. (AFOSR-64-2064) (AF EOAR-64-
24) AD 451719   Unclassified

Also published in Nuclear Instr. and Methods, v. 26:
219-220, 1964.

A detailed procedure for the preparation of sources of
Co^{57} for Mossbauer experiments, having narrow un-
split emission lines, is described.

956

Hebrew U. Dept. of Physics, Jerusalem (Israel).

MAGNETIC HYPERFINE INTERACTIONS AND RE-
LAXATION PHENOMENA IN PARAMAGNETIC Dy_2O_3,
by S. Ofer, B. Khurgin and others. [1964] [2]p. incl.
diagr. (AFOSR-64-2123) (AF EOAR-64-24)
AD 451576   Unclassified

Also published in Phys. Ltrs., v. 11: 205-206, Aug. 1,
1964.

This paper describes observations of the magnetic hy-
perfine splittings in the recoil-free absorption of the
26 kev gamma rays from Dy^{161}m in Dy^{161} situated in
paramagnetic polycrystalline Dy^{203}.

959

Hebrew U. Dept. of Physics, Jerusalem (Israel).

A METHOD OF DIFFERENTIATING BETWEEN
ATOMIC SPECTRA OF HIGH DEGREES OF IONIZA-
TION, by E. Alexander, U. Feldman, and B. S.
Fraenkel. [1964] [8]p. incl. illus. diagrs. tables.
(AFOSR-64-2149) (AF EOAR-64-70) AD 451567
                                        Unclassified

Also published in Jour. Quant. Spectros. and Radia-
tive Transfer, v. 4: 501-506, 1964.

It has been found that the intensity of spectra obtained
in the vacuum u. v. with a triggered vacuum spark
rises monotonely with the degree of ionization, when
compared with their intensity from a sliding spark.
In this way, differentiation between spectral lines of
different degrees of ionization can be made for ele-
ments with Z greater than 25. Various aspects of the
variation in intensity of spectra obtained by these
methods are discussed. (Contractor's abstract)

960

Hebrew U. Dept. of Psychology, Jerusalem (Israel).

CORRELATES OF AMBIVALENCE, RISK-TAKING

AND RIGIDITY, by A. Minkowich. June 1, 1964, 63p. incl. tables, refs. (Scientific rept. no. 1) (AFOSR-64-1486) (AF EOAR-63-62) AD 604585   Unclassified

An examination was made of the relationships of over 40 variables in 3 samples of subjects. The variables belonged to 5 classes: (1) Personality traits (ambivalence toward parents, siblings and authority figures, hostility toward the same figures, manifest anxiety, vacillation tendencies in risk taking and perception); (2) Socialization experiences (amount of parental reward and punishment experienced during childhood, frequency of psychological discipline and corporal punishment administered by each of the parents, strictness of religious upbringing); (3) Perceptual styles (field dependence, perceptual rigidity, intolerance of ambiguity); (4) Social attitudes and cognitive styles (authoritarianism, dogmatism); (5) Risk-taking behavior (playful risk, financial risk, physical risk, risk of prestige).

961

Henri Rousselle Hospital, Paris (France).

RELATION OF THE VISCERAL AFFERENTS TO THE ACTIVITY OF THE BRAIN STEM RETICULAR FORMATION, by P. C. Dell. Final technical rept. Feb. 10, 1959 - June 30, 1963, 24p. (AFOSR-64-1270) (AF 61(052)229) AD 602784   Unclassified

Summaries of research on (1) Bulbar control of mesencephalic reticular activation and the ensuing changes in galvic skin reflex, pupillary reactions and cortical arousal, (2) Reticular control of sensory system, (3) Vigilance and motor integration, and (4) Reticular activating system and the control of Respiration are presented.

962

Henri Rousselle Hospital, Paris (France).

VISCERAL AFFERENT ACTIVITY EFFECT ON BRAIN STEM RETICULAR FORMATION, by P. C. Dell. Technical final rept. July 1, 1963 - June 30, 1964. July 1, 1964 [9]p. (AFOSR-64-1651) (AF EOAR-63-52) AD 605727   Unclassified

The following themes were the object of investigations: (1) Afferent projections acting on the bulbar structures implied in the control of the reticular activating system (RAS). (a) Role of afferents of the IXth and Xth cranial nerves. (b) Role of afferents of spinal origin. (2) Ascending effects synchronized with the activity of the respiratory centers. (3) Comparative study of the immediate and delayed components of reticular responses.

963

Herman Föttinger Inst. für Strömungstechnik. Technische Universität, Berlin-Charlottenburg (Germany).

ON THE INSTABILITY AND NON-LINEAR DEVELOPMENT OF A DISTURBED SHEAR LAYER, by A. Michalke. May 31, 1963, 31p. (Technical note no. 2) (AFOSR-5170) (AF 61(052)412) AD 416371
Unclassified

An attempt is made to calculate approximately the non-linear development of a disturbed shear layer. The disturbance of the shear layer was obtained by the methods of the inviscid linearized stability theory. By means of the eigenfunctions of the problem the stream-lines of the disturbance motion were calculated. It was found that the disturbance of the shear layer is represented by two vortex sheets which will be superposed to the vorticity distribution of the undisturbed shear layer. According to Rosenhead's simplification the non-linear development was calculated by replacing the continuously distributed vorticity by a number of individual vortices and computing the motion of this vortices caused by the mutual induction. It was found that the disturbed shear layer rolls up and a concentration of vorticity results.

964

[Herman Föttinger Inst. für Strömungstechnik]. Technische Universität, Berlin-Charlottenburg (Germany).

GROWTH OF VELOCITY FLUCTUATIONS LEADING TO TURBULENCE IN FREE SHEAR FLOW, by R. Wille. June 30, 1963, 96p. (AFOSR-5325) (AF 61-(052)412) AD 418294   Unclassified

A special case of transition from laminar to turbulent flow is discussed: namely, a laminar free boundary layer, as it occurs at free jets near the nozzle, passes through the stages of meandering, vortex formation, and decay of laminar vortex flow. Hydrodynamic stability theory has been applied to the boundary layers of axisymmetric and two-dimensional jets. For experimental data the hot-wire technique has been applied. In many details experiment and theory are in good agreement, e.g. the frequencies of amplified velocity fluctuations. The characteristic data of vortex flow have been experimentally investigated using a Karman vortex street as model flow. The existence of a critical vortex number could be verified for one special case. The influence of the jet velocity profile at the origin of the jet on the axial and radial distribution of the mean velocity and the turbulent fluctuations has been studied experimentally. An experimental arrangement for producing free Couette flow is described and a first experimental analysis of the highly instable Couette jet is given.

985

Herner and Co., Washington, D. C.

A CASE STUDY IN THE APPLICATION OF CRAN-
FIELD SYSTEM EVALUATION TECHNIQUES, by S.
Herner, F. W. Lancaster, and W. F. Johanningsmeier.
1964, 14p. (AFOSR-64-2259) (AF 49(838)1182)
AD 808743   Unclassified

Presented at 148th meeting of the Amer. Chem. Soc.,
Chicago, Ill., Aug. 30 - Sept. 4, 1964.

An account is given of a project performed on behalf
of the U.S. Navy Bureau of Ships Technical Library
to evaluate the effectiveness of a computerized infor-
mation retrieval system based on the Engineers
Joint Council system of role indicators and links.
The evaluation method used was that developed by
Cleverdon in the ASLIB Cranfield Project. The
search program involved all major combinations of
appropriate descriptors and role indicators. Once the
searches were performed, the documents produced
were submitted to compilers of the original questions.
A basis was obtained for computation of relevance
ratios. Recall ratios were determined by actually do-
ing a total check of the specimen collection to locate
all documents that had any possible relevance to 10 of
the test questions. The greatest cause of noise in the
search results was searching errors, and the most
frequently occurring type of searching error was the
failure to select crucial terms or concepts in translat-
ing the questions into the language of the system. The
question was different on analysis for reasons for
failure to retrieve documents that were relevant to
search questions. Here, indexing errors contributed
more heavily to the cause of failure.

988

Herner and Co., Washington, D. C.

MATHEMATICS, MECHANICS, AND STATISTICS FOR
THE INFORMATION SCIENCE CURRICULUM OR,
WHAT MATHEMATICS DOES AN INFORMATION SCI-
ENTIST NEED? by R. A. Fairthorne. 1963, 2p.
(AFOSR-64-0238) (AF 49(638)1261) AD 432794
                                             Unclassified

Presented at Twenty-sixth annual meeting of the Amer.
Doc. Inst., Chicago, Ill., Oct. 1963.

Also published in Automation and Scientific Commun.,
p. 39-40.

Mathematics for the Information Scientist corresponds
with the 'Modern Mathematics' advocated for second-
ary schools. Information Scientists must be both
'literate' and 'numerate'. Finding empirical princi-
ples, usually 'Postulates of Impotence', must precede
mathematical deduction and theorem proving.

987

Herner and Co., Washington, D. C.

BASIC PARAMETERS OF RETRIEVAL TESTS, by
R. A. Fairthorne. [1964] [3]p. (AFOSR-65-0593)
(AF 49(638)1261) AD 616174   Unclassified

Also published in Proc. Amer. Documentation Inst.,
Philadelphia, Pa., Oct. 5-8, 1964, v. 1: 343-345,
1964.

Retrieval tests involve comparison of 2 partitions of
the collection, by the system and by the tester. Pa-
rameters should hold good both for all-but-not-only
(ABNO) and only-but-not-all (OBNA) systems; when
there are no items of the type invoked; and when "dis-
crimination" is separated from "identification." Thus
they are functions of those parameters of the 2×2
contingency table unaltered, except for sign, by row or
column interchange. These are interpreted in docu-
mentary terms.

968

Howard U., Washington, D. C.

ON INDUCED TRANSITIONS AND LINE SHIFTS IN THE
ROTATION-VIBRATION SPECTRA OF PRESSURIZED
DIATOMIC GASES, by R. D. Sharma and G. C. Turrell.
[1983] [9]p. (AFOSR-64-0220) (AF AFOSR-83-167)
AD 432509   Unclassified

Also published in Jour. Chem. Phys., v. 39: 2638-
2646, Nov. 15, 1963.

A simple model is developed for a collision pair con-
sisting of a polar diatomic molecule and a perturbing
inert gas atom. The effects of long-range forces
arising from the dipole and quadrupole moments of the
polar molecule on its rotation-vibration spectrum are
considered. Detailed calculations are carried out to
obtain the integrated intensities of the induced Q
branches and the rotational line shifts in the spectra of
HCl- and HBr-inert gas mixtures. The calculated re-
sults for both phenomena agree in magnitude with the
experimental data without the use of adjustable parame-
ters. The results are also consistent with the observed
temperature dependences of the Q-branch intensities.
In its present form the theory is unable to reproduce
quantitatively either the fine structure of the Q branch
or the J dependence of the line shifts.

969

Hull U. Dept. of Chemistry (Gt. Brit.).

THE REACTION OF HYDROGEN ATOMS WITH OXY-
GEN AND WITH ETHANE, by R. R. Baldwin and A.
Melvin. [1984] [7]p. incl. diagrs. tables, refs.
(AFOSR-84-1886) (AF EOAR-63-31) AD 449999
                                             Unclassified

Also published in Jour. Chem. Soc. (London), May
1964, p. 1785-1791.

Values of the Arrhenius parameters for the reaction $H + O_2 = OH + O$ have been obtained by combining estimates from shock tube studies at 1650°K, from flame studies at 1100°K, from studies of the $H_2 + O_2$ reaction at about 800°K, and from atomic reaction studies at 300°K. Statistical treatment gives $\log_{10} k_2 = 11.313 \pm 0.28 - (16,490 \pm 700)/4.576T$ in l. mol^{-1} sec^{-1} units. Similar treatment of values for the reaction $H + C_2H_6 = H_2 + C_2H_5$ from flame studies at 1100°K, from the inhibiting action of ethane on the $H_2 + O_2$ at 813°K, and from low-temperature studies of the reaction of H or D atoms with ethane gives $\log_{10} k_{14} = 11.117 \pm 0.25 - (9710 \pm 580)/4.576T$.

970

Hull U. Dept. of Chemistry (Gt. Brit.).

INHIBITION OF THE HYDROGEN + OXYGEN REACTION BY N- AND ISO-BUTANE, by R. R. Baldwin and R. W. Walker. [1964] [11]p. incl. diagrs. tables, refs. (AFOSR-64-1887) (AF EOAR-63-31) AD 450001
Unclassified

Also published in Trans. Faraday Soc., v. 60: 1236-1246, July 1964.

The inhibiting action of n- and iso-butane on the $H_2 + O_2$ reaction was examined over the temperature range 480-520°C in KCl-coated vessels. The second limit is reduced almost linearly as the mole fraction of hydrocarbon is increased, so that the efficiency of inhibition can be assessed by the mole fraction of inhibitor required to halve the unhibited limit. The marked dependence of inhibitor mole fraction on oxygen mole fraction shows that the main termination process is the reaction of H atoms with the hydrocarbon, though the decrease in inhibitor mole fraction with decreasing hydrogen mole fraction implies a significant contribution from the reaction of O or OH (or both) with the hydrocarbon. The butyl radicals appear to undergo predominantly a reaction with oxygen giving HO_2 and an olefine.

971

Hull U. Dept. of Chemistry (Gt. Brit.).

INHIBITION OF THE HYDROGEN-OXYGEN REACTION BY PROPANE, by R. R. Baldwin. [1964] [12]p. incl. diagrs. tables, refs. (AFOSR-64-1888) (AF EOAR-63-31) AD 450002
Unclassified

Also published in Trans. Faraday Soc., v. 60: 527-538, Mar. 1964.

The inhibiting action of propane on the second limit of the $H_2 + O_2$ reaction was studied over a wide range of mixture composition. The results were similar to those obtained with ethane and indicate that the main primary termination reaction is a removal of hydrogen atoms by propane. Removal of hydroxyl radicals, or oxygen atoms, though less important, accounts for secondary effects. Results indicate that the ultimate termination reaction is the reaction of the propyl radicals, formed in the large excess of phosphorus trichloride. This is considered to be evidence that the phosphinic acid exists in tautomeric equilibrium with the phosphonous acid form, the preparation of ferrocenylphosphonous dipiperide, the first known phosphorus amide of ferrocene, is reported.

972

Hull U. Dept. of Chemistry (Gt. Brit.).

THERMAL AND ISOTHERMAL EXPLOSIONS IN THE INHIBITION OF THE $H_2 + O_2$ REACTION BY HYDROCARBONS. INHIBITION BY NEOPENTANE, by R. R. Baldwin and R. W. Walker. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-65-2486) (AF EOAR-63-31) AD 629245
Unclassified

Also published in Trans. Faraday Soc., v. 60: 1760-1768, Oct. 1964.

Studies of the inhibiting action of neopentane on the second limit of the hydrogen + oxygen reaction shows that its behavior resembles that of methane, and differs markedly from that of ethane, propane, n- and iso-butane. These latter hydrocarbons inhibit the limit because the alkyl radicals formed in the primary termination processes react predominantly with oxygen to form an olefine and the inert HO_2 radical. A similar reaction is not possible with the neopentyl radical, so that there is no direct inhibition, and a 'degenerate' inhibition mechanism occurs, in which the inhibition is due to reaction products which have not reached a stationary concentration. Under these conditions, the normally isothermal explosion boundary becomes thermal in character, and confirmation of this change is provided by the effects of different inert gases and vessel diameters.

973

IIT Research Inst., Chicago, Ill.

ANALYTICAL INVESTIGATION OF COMBUSTION IN-
STABILITY IN SOLID PROPELLANT ROCKETS, by
F. L. Schuyler. Final rept. July 1, 1961-July 30,
1963. 77p. (Rept. no. A6002) (AF 49(638)1094)
AD 424195   Unclassified

An analysis has been performed to formulate an aero-
thermochemical model for the combustion of solid
rocket propellants in the presence of erosion. A two-
dimensional laminar boundary layer analysis has been
used to describe the flow, temperature, and concentra-
tion fields in the gas phase adjacent to the solid surface.
The temperature dependence of the gas-phase reaction
rate constant and of the solid pyrolysis have been de-
scribed by Arrhenius expressions. A parallel investi-
gation has been conducted to study the mechanisms of
the chemical reactions involved with the burning of
nitrocellulose type propellants.

974

Illinois Inst. of Tech., Chicago.

ROLE OF X-RAY INTENSITIES ON CRYSTAL PER-
FECTION STUDIES, by L. V. Azaroff. [1963] [16]p.
(AFOSR-J1127) (AF AFOSR-62-71) AD 421715
                                   Unclassified

Also published in Crystallography and Crystal Perfec-
tion, 1963, p. 109-124.

Present x-ray diffraction theory is based on an artifi-
cial "mosaic" crystal proposed by Darwin. In terms
of this model, crystal perfection can be related to the
intensity of an x-ray reflection via two factors called
primary and secondary extinction. It is possible to
evaluate these two terms independently either by com-
paring the reflecting powers of a single reflection at
different x-ray wavelengths or by comparing several
hkl reflections using the same wavelength. This
analysis yields an effective thickness for the "mosaic"
blocks and an average value for their relative tilts.
It is then possible to interpret Darwin's model of a
crystal in terms of dislocation theory. Relatively
large concentrations of point defects in a crystal modi-
fy its electron density distribution sufficiently to affect
the x-ray intensities. If the intensities are measured
accurately and are suitably processed, they can be
used to synthesize "difference" electron densities capa-
ble of disclosing the imperfections present. Both of the
above procedures have been used successfully and are
illustrated by applications to silicon and zinc oxide
crystals. The possible limitations of electron density
methods are illustrated by a study of indium antimo-
nide. (Contractor's abstract)

975

Illinois Inst. of Tech. Dept. of Metallurgical
Engineering, Chicago.

SUPPRESSION OF THE BAUSCHINGER EFFECT AND

CHANGES IN FLOW PATTERN OF DUCTILE METALS
CAUSED BY CYCLIC TORSIONAL STRAINS, by N. H.
Polakowski. [1963] 11p. incl. illus. diagrs. refs.
(AFOSR-64-0412) (AF 49(638)308)   Unclassified

Presented at Sixty-sixth annual meeting of the Amer.
Soc. for Testing and Materials, Atlantic City, N. J.,
June 23-28, 1963.

The Bauschinger effect, defined as the difference in
yield stresses for continued and reversed straining,
essentially disappears after a series of stress cycles of
decreasing amplitude. This applies to annealed and
initially cold-worked metals alike, although in the lat-
ter case the change is accompanied by an over-all de-
crease of the yield stress (fatigue softening). The at-
tenuation of the Bauschinger effect also leads to a con-
spicuous change in the deformation mode of cold-worked
(drawn, stretched) metals during subsequent continuous
torsion. The ordinarily observed propagation of flow by
Lüders-type shear bands recedes or, if the initial work-
hardening was moderate, it can be completely sup-
pressed and replaced by homogeneous flow. This is in-
dicative of a relation between the degree of work soften-
ing and the development and subsequent stabilization of
the Bauschinger effect with increasing prestrain.

976

Illinois U. [Charged Particle Research Lab.] Urbana.

PHOTOMICROGRAPHY OF ELECTRICALLY SPRAYED
HEAVY PARTICLES, by C. D. Hendricks, Jr., R. S.
Carson and others. [1963] [6]p. (AFOSR-176)
(AF AFOSR-63-107) AD 406645   Unclassified

Presented at AIAA Electric Propulsion Conf., Colo-
rado Springs, Mar. 11-13, 1963.

Also published in AIAA Jour., v. 2: 733-737, Apr.
1964. (AFOSR-64-1671)

One of the methods used to produce charged droplets,
based on the electrical spraying of liquids from the tip
of a conducting capillary tube, is briefly described.
High-speed photomicrographs are shown which reveal
details of the spraying mechanism at atmospheric pres-
sure and at a pressure of about 10^{-5} torr for both sta-
tionary and pulsed conditions. The pictorial evidence
is interpreted and discussed in terms of the physical
constants of the liquids and the external parameters.
Distributions of specific charge for several different
liquids are presented and discussed briefly. The pos-
sibility of predicting and controlling the specific-
charge distribution by electrical means is examined and
recent achievements presented.

977

Illinois U. Charged Particle Research Lab., Urbana.

ELECTRICAL SPRAYING OF MACROSCOPIC LIQUID
PARTICLES UNDER PULSED CONDITIONS, by R. S.
Carson. Jan. 15, 1964, 91p. incl. illus. diagrs. refs.
(Rept. no. CPRL-1-64) (AFOSR-64-1470) (AF AFOSR-
63-107) AD 604428   Unclassified

An historical treatment is used to point out that an important application of electrical spraying is in the electrical propulsion field. It was found that glycerine, Octoil, and Octoil doped with tetra-no-butylammonium picrate readily spray from the end of a fine capillary, maintained at a high d-c potential, in short periodic bursts which continue over a prolonged time interval of at least several hours. New techniques are presented for determining the specific-charge spectra of the droplets emitted in selected intervals during the spraying pulses by time-of-flight mass spectrometry, and for taking photomicrographs of the liquid surface at any instant before, during, and after the spraying pulses. A method for synchronizing the spraying to an external pulses is indicated.

976

Illinois U. Charged Particle Research Lab., Urbana.

THE STABILITY OF ELECTRIFIED LIQUID SURFACES, by J. M. Schneider. Mar. 5, 1964, 99p. incl. illus. diagrs. refs. (Rept. no. CPRL-2-64) (AFOSR-64-1474) (AF AFOSR-63-107) AD 604431
Unclassified

The study pertains to the stability of electrified liquid surfaces. The emphasis is placed upon the stability conditions which apply to liquids sprayed from a small cylindrical capillary tube. For the case of low flow rates a particular value of applied electric potential exists, above which, the liquid surface is unstable due to electrostatic forces. Calculations of the value of the minimum spraying potential are made using a modification of a theory originated by Rayleigh. The values of the minimum spraying potential thus obtained are compared to values determined from calculations made by Zeleny. For the case of high flow rates the jet is unstable under the action of surface tension provided that the wavelength of any disturbance on the jet is greater than the circumference of the jet. If charge is present on the jet, the forces due to the charge promote stability if the wavelength of the disturbance is greater than 0.6 times the circumference of the jet. If the wavelength of the disturbance is less than 0.6 times the circumference of the jet, the effect of charge on the jet promotes instability.

979

Illinois U. Charged Particle Research Lab., Urbana.

PARAMETERS INFLUENCING THE CHARGE-TO-MASS RATIO OF ELECTRICALLY SPRAYED LIQUID PARTICLES, by J. J. Hogan. Dec. 15, 1963, 127p. incl. illus. diagrs. tables, refs. (Rept. no. CPRL-2-63) (AFOSR-64-1478) (AF AFOSR-63-107) AD 604583
Unclassified

A theoretical study of the electrical dispersion process is presented. The study includes: (1) surface energy minimization of the dispersed system of particles, (2) solution of Poisson's equation and the influence of space charge on the specific charge of the emitted particles, and (3) the influence of the conductivity and temperature of the liquid on the generation of

charged particles. It is proposed that an equilibrium is established among the voltage drop across the liquid meniscus at the capillary tip, the space charge in the vicinity of the source, and the surface energy minimization process—and that the specific charge of emitted drops is established as a result of this equilibrium.

980

Illinois U. Coordinated Science Lab., Urbana.

THE SCATTERING MATRIX: NORMALIZED TO COMPLEX n-PORT LOAD NETWORKS, by R. A. Rohrer. May 1964, 33p. incl. diagrs. (Rept. no. R-206) (AFOSR-64-1115) (DA 26-043-AMC-0073(E)) AD 601157
Unclassified

The scattering matrix was normalized to complex n-port loads and some of the elementary properties of this generalized scattering matrix are discussed. The normalized scattering matrix was obtained in a straight-forward manner from both the current-basis and voltage-basis scattering matrices. These matrices are presented from the intuitively attractive viewpoint of measures of the deviation of actual circuit behavior. The optimal matching condition employed was the specialization to the time-invariant case of that obtained for complex, time-varying n-port networks excited by arbitrary wave-forms. (Contractor's abstract)

981

Illinois U. Coordinated Science Lab., Urbana.

PROPERTIES OF CLASSES OF PATHS, by W. Mayeda. May 1964, 14p. incl. diagrs. (Rept. no. R-212) (AFOSR-64-1117) (DA 28-043-AMC-00073(E)) AD 601155
Unclassified

The properties of paths between a pair of vertices in a nonoriented linear graph have been discussed by several papers. This paper gives the properties of a class of paths where each class consists of all possible paths between a pair of vertices in a nonoriented, non-separable linear graph. It is clear that such properties should be known when one synthesizes a s.c. switching network which satisfies a set of given switching functions. An interesting application of classes of paths is to obtain all possible trees in a linear graph which is shown at the end of the paper. (Contractor's abstract)

982

Illinois U. Coordinated Science Lab., Urbana.

ON AN IMPROVED DIAGNOSIS PROGRAM, by S. Seshu. May 1964, 14p. incl. diagr. (Rept. no. R-207) (AFOSR-64-1118) (DA 28-043-AMC-00073(E)) AD 601156
Unclassified

In an earlier paper an IBM 7090 program for the diagnosis of asynchronous circuits was described. The present note describes an improved version written for the CDS-1604 computer. The principal

improvements are in flexibility and intelligence. The present program was written as a tool of research in the problem of self-diagnosis in electronic digital computers. (Contractor's abstract, in part.

983

Illinois U. Coordinated Science Lab., Urbana.

CROSSED FIELD CHARGED PARTICLE DELAY LINES, by H. G. Slottow. June 1964, 171p. incl. illus. diagrs. refs. (Rept. no. R-214) (AFOSR-64-1353) (DA 28-043-AMC-00073(E)) AD 602090
Unclassified

Crossed electric and magnetic fields are used to focus a beam of charged particles and to control the drift velocity of these particles. The novel and useful properties are: (1) the time delay can be varied continuously and rapidly; (2) the frequency band is potentially very wide. A discussion of the effects that limit bandwidth is presented and several means for reducing the limitations are described. In particular, a hyperboloidal structure is described that can maintain equal flight times in circular delay lines; the use of plasmas is discussed, and the field averaging properties of high energy electrons is analyzed. Experiments are described in which electrons or ions drifting at speeds less than 10^4 meters/sec delay signals by as much as 50 μsec. Results, usually in the form of oscillograms, show the effects of space charge, and in the case of tenuous plasmas, the effects of pressure on the shapes of video pulses. (Contractor's abstract)

984

Illinois U. Coordinated Science Lab., Urbana.

ROLE OF THE GENERALIZED LIPSCHITZ CONDITION IN FINITE-TIME STABILITY AND IN THE DERIVATION OF THE MAXIMUM PRINCIPLE, by S. D. Agashe. June 1964, 26p. (Rept. no. R-215) (AFOSR-64-1354) (DA 28-043-AMC-00073(E)) AD 602143
Unclassified

The main purpose of the report was to show how important the generalized Lipschitz condition is in proving certain properties of varied solutions of differential equations. These are particularly useful in consideration of finite-time stability and in deriving the Pontryagin maximum principle. It was shown that if a system satisfies a generalized Lipschitz condition in the state variables, it is finite-time stable with respect to the initial stage. If it satisfies a generalized Lipschitz condition in the control, it is finite-time stable with respect to the control. In deriving the maximum principle using the calculus of variations approach, an implicit assumption was made that for sufficiently small variations of the optimum control, the terminal conditions of the problem can still be met. This assumption was shown to be valid if a generalized Lipschitz condition is satisfied.

985

Illinois U. Coordinated Science Lab., Urbana.

CONTROL OF CO-OPERATIVE SYSTEMS: THE RENDEZVOUS PROBLEM, by D. L. Gieseking. July 1964, 52p. incl. diagrs. refs. (Rept. no. R-218) (AFOSR-64-1355) (DA 28-043-AMC-00073(E)) AD 603015
Unclassified

A study of optimal rendezvous strategies for cooperative controlled systems is presented. By rendezvous, it is meant that the systems approach each other in such a way that the system's velocities and accelerations are the same when the positions become the same. A solution to the single-input problem, using the calculus of variations, is given when the performance index is the integrated-square-error plus weighted control. A solution to the multi-input problem, using Pontryagin's maximum principle, is given for the same performance index. The performance index is rewritten in terms of the stacked state vectors. The rendezvous conditions are adjoined as constraints to the performance index using Lagrange multipliers. Due to the complexity of the problem, the control law will be open loop, in general.

986

Illinois U. Coordinated Science Lab., Urbana.

A PERFORMANCE MEASURE FOR GAME-PLAYING PROGRAMS, by E. G. Manning. May 1964, 39p. incl. diagrs. (Rept. no. R-208) (AFOSR-64-1557) (DA 28-043-AMC-00073(E)) AD 601621
Unclassified

A performance measuring procedure for a class of games is described. An example of the use of the procedure is given, with results. Further work to be done with the heuristic program at hand as well as with a new heuristic program is proposed. Lastly, another use of the safe-unsafe theorem, as a valuable aid to understanding heuristic programs, is suggested

987

Illinois U. Coordinated Science Lab., Urbana.

SYNTHESIS OF PROBABILISTIC COMMUNICATION NETS, by H. M. Barnard. May 1964 [54]p. incl. refs. (Rept. no. R-209) (AFOSR-64-1558) (DA 28-043-AMC-00073(E)) AD 601620
Unclassified

In this thesis the necessary and sufficient conditions for an expected value terminal capacity matrix to be realized as a net with a tree structure are developed. There are two reasons for the constraint that the net have a tree structure. First, it is well known in the classical communication synthesis problem that if a realization exists, then a realization with a tree structure always exists. Secondly, since the path between two vertices in a tree is unique Fu's equation for computing the expected value terminal capacity for these vertices reduces to a simple form. The expected value terminal capacity for vertices i and j in a tree net is

the product of the edge probabilities in the path between vertices i and j multiplied by the edge weight which has the minimum value in that path.

988

Illinois U. Coordinated Science Lab., Urbana.

TIME OPTIMAL CONTROL OF NON-LINEAR SAMPLED-DATA SYSTEMS, by S. M. Win. May 1964 [72]p. incl. diagrs. refs. (Rept. no. R-210) (AFOSR-64-1559) (DA 28-043-AMC-00073(E)) AD 601822   Unclassified

Procedures for the investigation of controllability, attainability and reachability of sampled-data systems with saturation constraints are presented. Necessary and sufficient conditions for complete controllability, attainability and reachability of single-input, time-invariant, sampled-data systems with saturation constraints are given. Conditional controllability, attainability and reachability are introduced and sufficient conditions are derived. Complete controllability and attainability of time-varying systems are investigated also. Simple sufficient conditions are derived when the system matrices are either asymptotic to constant matrices or periodic. Procedures for the formulation of optimal strategies are discussed. The optimal strategy used in this thesis involves forcing the system to the boundary surface first, and then to the desired state.

989

Illinois U. Coordinated Science Lab., Urbana.

SOME APPLICATIONS OF LINEAR GRAPHS, by W.-K. Chen. May 1964 [51]p. incl. diagrs. refs. (Rept. no. R-211) (AFOSR-64-1560) (DA 28-043-AMC-00073(E)) AD 801623   Unclassified

The following topics are discussed: On the modifications of flow graphs; Flow graphs and bipartite graphs; An extension of the star-mesh transformation; A simplified way of solving a system of simultaneous linear equations; and On signal-flow graphs.

990

Illinois U. Coordinated Science Lab., Urbana.

SENSITIVITY CONSIDERATIONS IN OPTIMAL SYSTEM DESIGN, by R. A. Rohrer and M. Sobral. June 1964, 25p. incl. diagrs. (Rept. no. R-213) (AFOSR-64-1581) (DA 28-043-AMC-00073(E)) AD 443853   Unclassified

The sensitivity of a control system is usually taken to be the normalized variation of some desired characteristic with the variation of plant or controller parameters. Rather than the usual absolute sensitivity described above, a new definition of relative sensitivity is introduced for the optimal control problem, wherein the system performance is always compared with its optimum under the given circumstances. The implica-

tions of the relative sensitivity and its relevance to optimal system design are discussed in detail. Moreover, a theoretical approach to the problem of system optimization when plant parameters are subject to change is presented. (Contractor's abstract)

991

Illinois U. Coordinated Science Lab., Urbana.

ON QUASI-LINEAR SEQUENTIAL MACHINES, by H. Y. Chang. July 1964 [41]p. incl. diagrs. refs. (Rept. no. R-216) (AFOSR-64-1562) (DA 28-043-AMC-00073(E)) AD 442308   Unclassified

The thesis investigates the realizability of quasi-linear sequential machines, machines that are linear in the feedback variables but not necessarily in the input variables. First it is shown that many of the properties of linear sequential machines also apply to quasi-linear sequential machines. A number of sets of states in a quasi-linear sequential machine have certain algebraic properties that are reflected by the symmetries in the state diagram. A necessary and sufficient condition is obtained for a given connection matrix of a completely specified sequential machine, with the given coding of states, to be realizable as a quasi-linear sequential machine making use of minimal number of feedback lines. A canonical realization is discussed which enables one to realize any arbitrary state diagram as a quasi-linear sequential machine using a sufficiently large number of memory elements. (Contractor's abstract)

992

Illinois U. Coordinated Science Lab., Urbana.

PRINCIPLES AND APPLICATIONS OF UNISTOR GRAPHS, by G. G. Dodd. July 1964, 47p. incl. diagrs. refs. (Rept. no. R-217) (AFOSR-64-1583) (DA 28-043-AMC-00073(E)) AD 604095   Unclassified

New properties and applications of unistor graphs are presented. A technique for solving a set of linear equations is derived and an alternative graphical representation of an active network is given. Communication nets are treated for the first time by unistor graph techniques. A unistor is an oriented edge connecting two vertices in a graph. A flow exists in the oriented edge with a value equal to the product of the edge weight and the weight of the initial vertex. The unistor is characterized by flow, potential, admittance, and directedness-four properties also found in linear equations and electrical networks. It is shown that a unistor graph can represent a matrix and the determinant and cofactors can be evaluated by using directed trees and directed 2-trees.

993

Illinois U. Coordinated Science Lab., Urbana.

MEMORY EFFECTS IN THE CURRENT-VOLTAGE CHARACTERISTICS OF THIN FILM SANDWICHES, by

by G. Riddle. July 1964, 21p. incl. illus. diagrs.
(Rept. no. R-219) (AFOSR-64-1564) (DA 28-043-
AMC-00073(E)) AD 443854   Unclassified

Some new electrical effects were found in thin insulat-
ing films sandwiched between metal film electrodes.
Most measurements were made on $Al-Al_2O_3-Au$ three-
layer devices which were produced by vacuum deposi-
tion and anodization. The dielectric thickness was 100
to 1000 A. Electrical measurements were made in
darkness and under vacuum. Currents through the in-
sulator were measured as a function of applied voltage.
Fresh films displayed an exponential dependence of cur-
rent on voltage at low voltages. If the sandwiches
were exposed to more than a few volts, they underwent
an irreversible "forming" process. The formed sand-
wiches displayed interesting current-voltage relation-
ships, including instabilities, negative resistance,
and memory effects.

994

Illinois U. Coordinated Science Lab., Urbana.

A STUDY OF NONLINEAR SECOND ORDER SYSTEMS,
by J. K. Aggarwal. July 1964 [97]p. incl. diagrs.
table, refs. (Rept. no. R-223) (AFOSR-64-1565)
(DA 28-043-AMC-00073(E)) AD 443855
                                   Unclassified

Nonlinear second order systems, which are described
by a pair of coupled first order differential equations,
were studied. The behavior of trajectories in the
neighborhood of a singular point and the behavior of
trajectories in the large were examined.

995

Illinois U. Coordinated Science Lab., Urbana.

NONLINEAR NETWORK ANALYSIS - THE PARA-
METRIC APPROACH, by L. O. Chua and R. A.
Rohrer. July 1964, 186p. incl. diagrs. tables, refs.
(Rept. no. R-224) (AFOSR-64-1566) (DA 28-043-
AMC-00073(E)) AD 604039   Unclassified

This work presents a unified theory of nonlinear RLC
networks using an entirely new approach--the para-
metric approach. The class of networks considered
includes any arbitrary time-invariant, nonlinear RLC
network whose elements can be characterized by a
unicursal curve. In particular, curves which are mul-
tiple-valued functions of both terminal variables such
as the hysteresis curves are admissible. Through
the use of Stieltjes integrals, a generalization of the
concepts of 'content' and 'co-content' as well as 'en-
ergy' and 'co-energy' is made which leads directly to
a generalization of the Legendre transformation. It
is then shown that the equilibrium equations of such
networks can always be formulated mathematically as
a system of algebraic-differential equations. The
Schauder fixed point theorem and the principle of con-
traction mapping are then used to formulate a number
of existence theorems on the solutions of nonlinear re-
sistive networks.

996

Illinois U. Coordinated Science Lab., Urbana.

REALIZATION OF THE A-MATRIX OF HALF-DEGEN-
ERATE RLC NETWORKS, by A. Dervisoglu. July
1964, 56p. incl. diagrs. refs. (Rept. no. R-225)
(AFOSR-64-1567) (DA 28-043-AMC-00073(E))
AD 603686   Unclassified

The necessary and sufficient conditions for a matrix
to be realizable as the A-matrix of an RLC network are
developed. The RLC network is assumed to be nonde-
generate or half-degenerate and is assumed to have a
connected resistive part. First it is shown that if there
exists a realization then the given matrix A can be fac-
tored into two matrices: one a diagonal matrix of posi-
tive entries and the other a symmetric-skewsymmetric
(hybrid) matrix. It is shown that the given matrix A
has a realization with a half-degenerate or non-degen-
erate RLC network which has a connected resistive
part if and only if the factorization exists and both the
terminal matrix and the circuit matrix are realizable.

997

Illinois U. Coordinated Science Lab., Urbana.

THE SENSITIVITY OF GENERAL MULTIVARIABLE
FEEDBACK SYSTEMS, by J. B. Cruz, Jr. and W. R.
Perkins. Aug. 1964 [12]p. incl. diagrs. (Rept. no.
R-227) (AFOSR-64-1568) (DA 28-043-AMC-00073(E))
AD 604096   Unclassified

The new approach recently proposed by the authors for
treating the parameter variation problem for a class of
multivariable systems is extended to a general feed-
back configuration for multivariable systems. It is
shown that the general linear, multivariable, feedback
system can be represented by two plant transfer func-
tion matrices and three controller transfer function
matrices. A formula for the sensitivity matrix of the
general structure is derived. Also, sufficient condi-
tions are obtained for assuring a feedback design that
is less affected by parameter variations than another
feedback design with the same overall transfer matrix.
(Contractor's abstract)

998

Illinois U. Coordinated Science Lab., Urbana.

ON CERTAIN RELAXATION OSCILLATIONS: CON-
FINING REGIONS, by P. J. Ponzo and N. Wax. July
1964 [43]p. incl. diagrs. (Rept. no. R-228) (AFOSR-
64-1569) (DA 28-043-AMC-00073(E)) AD 603688
                                   Unclassified

Relaxation oscillations described by the generalized
Lienard equation are investigated in the phase and
Lienard planes. When f(x), g(x), and F(x) =
$\int_0^x f(u)du$ are subject to certain restrictions, a number
of analytic curves can be obtained in these planes which
serve as bounds on solution trajectories. Piece-wise
connection of such bounding curves provide explicit

annular regions with the property that solution tra-
jectories on the boundary of an annulus move to the in-
terior with increasing time, t. The Poincare-Bendix-
son theorem then guarantees at least one periodic orbit
within such an annulus. It is shown that the periodic
orbits which are isolated by this means are unique
within the annulus, hence orbitally stable. (Contrac-
tor's abstract in part)

999

Illinois U. Coordinated Science Lab., Urbana.

ON CERTAIN RELAXATION OSCILLATIONS: ASYMP-
TOTIC SOLUTIONS, by P. J. Ponzo and N. Wax.
July 1964 [47]p. incl. diagrs. (Rept. no. R-229)
(AFOSR-64-1570) (DA 28-043-AMC-00073(E))
AD 603687   Unclassified

Periodic solutions of the generalized Lienard equation
are investigated in the phase and Lienard planes. Cer-
tain comparison equations are obtained by modifying the
functions $f(x)$, $g(x)$, $F(x) = \int_0^x f(u)du$ so that the resulting
equations may be integrated to within an error of order
μ^{-2}.

1000

Illinois U. Coordinated Science Lab., Urbana.

ANOMALOUS CURRENT PEAKS IN THE I-V CHARAC-
TERISTIC FOR TUNNELING BETWEEN TWO SUPER-
CONDUCTORS, by M. G. Craford, R. N. Peacock and
others. Aug. 1964, 9p. incl. diagrs. (Rept. no. R-
232) (AFOSR-64-1571) (DA 28-043-AMC-00073(E))
AD 604097   Unclassified

A study was made of the two-superconductor tunneling
characteristics of sandwiches of Nb-Nb Oxide-In. Ob-
servation was made of not only the dc Josephson effect
(a zero-voltage tunneling supercurrent), but also, at
finite voltages, dc current peaks of comparable mag-
nitude. A similar effect has been seen in junctions
exhibiting dc zero-voltage currents apparently due to
low critical current superconducting shorts.

1001

Illinois U. Coordinated Science Lab., Urbana.

OPTIMAL MATCHING OF NONLINEAR n-PORT NET-
WORKS, by R. A. Rohrer and J. P. Herner. July
1964, 22p. incl. diagrs. (Rept. no. R-221) (AFOSR-
64-1898) (DA 28-043-AMC-00073(E)) AD 605419
                               Unclassified

The classical calculus of variations is applied to find
the conditions for maximum energy transfer in non-
linear n-port networks. The general matching prob-
lem is discussed, and the sufficient conditions for the
optimal load network are given in terms of the time
domain behavior of the network. The optimal match
for a tunnel diode is given as a specialization of the
general results. (Contractor's abstract)

1002

Illinois U. Coordinated Science Lab., Urbana.

THE LOGIC ORGANIZER AND DIAGNOSIS PROGRAMS,
by S. Seshu. July 1964, 88p. incl. diagrs. tables.
(Rept. no. R-226) (AFOSR-64-1899) (DA 28-043-
AMC-00073(E) and AF 49(638)1383) AD 605927
                               Unclassified

The first part of the report is a user's manual for those
wishing to use the system of programs for the diagnosis
of sequential switching circuits. The second part is a
programmer's manual. Detailed description of the in-
dividual sub-routines, including calling sequences and
peculiarities are given. This system of programs was
developed as a tool in the experimental study of self-
diagnosis in electronic digital computers. The system
consists of two programs--the organizer (5000 instruc-
tions) and the sequential circuit analyzer (10,000 in-
structions) with about 1500 instructions in common.

1003

Illinois U. Coordinated Science Lab., Urbana.

AN EXTENSION OF DASHER SYNTHESIS, by B. D.
Elliott. Aug. 1964, 41p. incl. diagrs. refs. (Rept. no.
R-231) (AFOSR-64-1900) (DA 28-043-AMC-00073(E)
and AF 49(638)1383) AD 605420   Unclassified

A study is given of conditions under which a specified
nonminimum phase transfer function may be realized
as a cascade of common terminal RC structures, each
of which realizes a pair of complex zeros. Specifical-
ly, conditions are derived which must be satisfied by a
driving point admittance if a section producing a pair
of zeros in a portion of the right half-plane is to be re-
moved and an RC function is to remain. The simplest
section parameters consistent with this objective are
chosen and inequalities are derived which assure posi-
tive solutions for the unspecified constants. A technique
is also derived for the conversion of the complete ad-
mittance description of a common terminal section to a
physical network based on node insertion in the admit-
tance matrix and sufficient inequalities are given.
(Contractor's abstract)

1004

Illinois U. Coordinated Science Lab., Urbana.

INITIATION OF ELECTRICAL BREAKDOWN IN UL-
TRAHIGH VACUUM, by D. Alpert, D. A. Lee and
others. Aug. 1964, 1v. incl. illus. diagrs. refs.
(Rept. no. R-234) (AFOSR-64-1902) (DA 28-043-
AMC-00073(E)) AD 605426   Unclassified

Existing theories for the initiation of electrical break-
down are reviewed, together with the experimental ob-
servations on which they are based. Experiments de-
scribed have extended the available data on electrical
breakdown between broad area electrodes under ultra-
high vacuum conditions. The results are interpreted

on the basis of a single picture which explains and relates the phenomena of predischarge currents and the initiation of breakdown.

1005

Illinois U. Coordinated Science Lab., Urbana.

GENERATIONS OF TREES WITHOUT DUPLICATIONS, by W. Mayeda and S. Seshu. July 1964, 16p. (Rept. no. R-220) (AFOSR-64-2137) (DA 28-043-AMC-00073(E) and AF 49(638)1383) AD 604653
Unclassified

The purpose of this note is to describe a procedure for generating all trees of a linear graph without duplication. The trees are generated in a systematic fashion by elementary tree transformations (replacement of one branch), and hence the sign computation is performed simply. Since the procedure guarantees that there is no duplication, networks in which the number of trees exceeds the fast memory available in a computer, can be handled. The procedure requires that one generate a starting tree, which is easy to do on a machine, and that one compute the fundamental cut-sets for a given tree, which is again easy to do.

1006

Illinois U. Coordinated Science Lab., Urbana.

DISTRIBUTED NETWORK SYNTHESIS AND APPROXIMATION IN THE TIME DOMAIN, by R. A. Rohrer, J. A. Resh, and R. A. Hoyt. July 1964 [23]p. incl. diagrs. refs. (Rept. no. R-222) (AFOSR-64-2358) (DA 28-043-AMC-00073(E)) AD 607711
Unclassified

Conditions are obtained for the realization of the best approximation to a desired time domain input-output relation by means of a distributed network of a given class. Practical constraints are considered in obtaining the optimal (one-dimensional) spatial dependence for a series R-L, shunt G-C distributed network. The general results are specialized to L-C and R-C lines. (Contractor's abstract)

1007

Illinois U. Coordinated Science Lab., Urbana.

STATE MODELS OF ACTIVE RLC NETWORKS, by A. Dervisoglu. Dec. 1964, 13p. incl. diagrs. (Rept. no. R-237) (AFOSR-65-0256) (DA 28-043-AMC-00073(E)) AD 609700
Unclassified

In active RLC networks in which dependent sources are controlled by passive elements, the existence of a tree which contains all voltage sources as branches and all current sources as chords is only a necessary condition for a unique solution. Unlike the passive case, the order of state vector depends not only on the topology of the network but also on the controlling coefficients of the dependent sources in the network. Furthermore, in a passive case if state variables are

the currents of inductors and voltages of capacitors, at most the first derivative of the input vector u may appear in the state model but in an active case the nth derivative may appear, where n is the number of reactive elements in the network.

1008

Illinois U. Coordinated Science Lab., Urbana.

A DESCRIPTIVE LIST OF PLATO LESSON PROGRAMS 1960-1964, by E. R. Lyman. Nov. 1964, 6p. incl. refs. (Rept. no. R-186) (AFOSR-65-0257) (DA 28-043-AMC-00073(E)) AD 609699
Unclassified

For the past three years, the Coordinated Science Laboratory has been developing an automatic teaching system called PLATO (Programmed Logic for Automatic Teaching Operation) in order to explore the possibilities of automation in individual instruction. In the course course of development 43 lesson programs have been written for the system to illustrate or demonstrate the flexibility of the system for instruction. This report lists and briefly describes the nine sequences (24 lessons) which were written for the tutorial logic and the eleven sequences (17 lessons) written for the inquiry logic. The version of the PLATO system for which the lessons were written is specified in each instance. PLATO I and PLATO II lessons are no longer operable on the PLATO system because the PLATO I and PLATO II systems are now obsolete.

1009

Illinois U. Coordinated Science Lab., Urbana.

LIMIT CYCLES IN A CERTAIN CLASS OF SAMPLED-DATA CONTROL SYSTEMS, by R. A. Werner. Dec. 1964, 91p. incl. diagrs. (Rept. no. R-238) (AFOSR-65-0258) (DA 28-043-AMC-00073(E) and AF 49(638)-1383) AD 610099
Unclassified

This paper discusses periodic, unforced solutions (called limit cycle solutions) to the state and output equations of a certain class of nonlinear sampled-data control systems. The class of systems consists of a linear plant, a single nonlinearity, a sample and hold element and a single feedback loop. Two different methods are given for determining the possible existence and the solutions for the limit cycles. An approximate method for determining possible existence and output solutions for limit cycles is also given. Finally, a certain kind of stability of limit cycle solutions is defined, and sufficient conditions for the stability and instability of limit cycles are developed. (A limit cycle is defined as a periodic trajectory in the state space; i.e., it is an unforced, periodic, steady state solution to the state space equations of the system.) (Contractor's abstract)

1010

Illinois U. Coordinated Science Lab., Urbana.

CRYSTALLIZATION OF THE SUPERCONDUCTOR

Nb_3Sn, by W. C. Leung. May 1963, 35p. incl. illus. diagrs. tables, refs. (Rept. no. R-170) (AFOSR-5476) (DA 36-039-AMC-02208(E))　　Unclassified

Studies and experiments on the crystallization of Nb_3Sn have been done on the basis of the following information: (1) Nb_3Sn is stable at 900°C and above, (2) appreciable amounts of Nb can be dissolved in Sn at 1200°C, and (3) nucleation and growth are the result of the continuous supersaturation at a particular location in a saturated solution. Experimental results clearly indicate that crystallization of Nb_3Sn will occur from a saturated solution of niobium in tin; however, due to excessive nucleation only polycrystalline clusters of Nb_3Sn crystals were achieved. More detailed studies and experimental investigation are required to obtain the optimum conditions for single crystal growth.

1011

Illinois U. Coordinated Science Lab., Urbana.

ATOMIC PROCESSES IN HELIUM-KRYPTON AND HELIUM-XENON MIXTURES, by C. L. Chen. June 1963, 31p. incl. illus. diagrs. table, refs. (Rept. no. R-171) (AFOSR-5477) (DA 36-039-AMC-02208(E))
　　Unclassified

The momentum transfer collision frequency of thermal electrons with neutrals in a decaying plasma established in helium-krypton and helium-xenon mixtures of known proportions were measured by microwave interferometer at gas temperatures of ~200 to 600°K. The energy dependences of the momentum transfer cross sections of electrons with krypton and xenon atoms deduced from these measurements are given. Mobilities of Kr^+ and Xe^+ in helium and in their respective parent gas have also been determined. A study of the pressure dependence of the characteristic time constants of the electron density decay at fixed ratios of krypton to helium and xenon to helium concentrations yields the three body conversion frequency of atomic krypton and xenon ions to their respective molecular ions.

1012

Illinois U. Coordinated Science Lab., Urbana.

UPPER BOUNDS FOR THE MEAN LIFE OF SELF-REPAIRING SYSTEMS, by J. Kruus. July 1963 [38]p. incl. diagrs. tables, refs. (Rept. no. R-172) (AFOSR-5478) (DA 36-039-AMC-02208(E)) AD 418174
　　Unclassified

Upper bounds are obtained for the mean life of a self-repairing system consisting of several identical machines, spare parts, and the necessary connecting and wiring mechanism. No detailed knowledge is assumed about the machines, except that each is by itself capable of performing the function required of the system, and that three of these machines may be interconnected to diagnose and direct the repair of a

suspected fault in a fourth machine. The time required for diagnosis and repair is a random variable. System mean life is obtained by selecting random machine lifetimes for a system simulated on an electronic computer. The switching mechanism is assumed to function without failures. The computation time is of the order of .2 msec for each time a machine is put into operation. System mean life is found to be quite sensitive to changes in the stress factor of spare machines.

1013

Illinois U. Coordinated Science Lab., Urbana.

ON THE SYNTHESIS OF OPTIMUM MULTIVARIABLE SYSTEMS, by R. Narayanasamy. July 1963 [75]p. incl. diagrs. refs. (Rept. no. R-173) (AFOSR-5479) (DA 36-039-AMC-02208(E)) AD 418160
　　Unclassified

A system with a feedback configuration is considered and this system is represented by an equivalent cascade systems. Two independent transfer matrices represented in the cascade system are first synthesized. The transfer matrices in the feedback configuration are then solved from the transfer matrices in the cascade system. There is chosen one of the transfer matrices in the cascade system to minimize the effect of certain disturbances in the system outputs and system sensitivity with respect to plant parameter variations. Also, system stability and physical realizability of the controllers in the feedback configuration are considered in the choice of this transfer matrix.

1014

Illinois U. Coordinated Science Lab., Urbana.

ON NETWORKS AND BI-COMPLETE GRAPHS, by J. A. Resh. July 1963 [66]p. incl. diagrs. refs. (Rept. no. R-174) (AFOSR-5480) (DA 36-039-AMC-02208(E)) AD 418172　　Unclassified

Mathematically, a communication network is a network (bi-complete linear graph) whose edge weights are restricted to be nonnegative. In the physical interpretations which generated this interest, the property which occupies the center of attention is the capacity of the network for supporting a flow from one terminal to another. It is this preoccupation with "generalized plumbing" that distinguishes the theory of communication networks from other mathematical systems dealing with weighted graphs.

1015

Illinois U. Coordinated Science Lab., Urbana.

BASHKOW'S A MATRIX FOR ACTIVE R. L. C. NETWORKS, by A. Dervisoglu. July 1963 [12]p. (Rept. no. R-175) (AFOSR-5481) (DA 36-039-AMC-02208(E)) AD 420507　　Unclassified

In 1957 Bashkow described a new method of network

analysis. According to this method if voltages across capacitances and currents through inductances are used as dependent variables, a set of first order differential equations is obtained as, $y = A y + F$ in which y is the column matrix of dependent variables and F represents the sources. Bryant later obtained an explicit form of A matrix for RLC networks. There is a discussion of the active RLC case such that the order of complexity of the network is equal to the number of reactive elements in the network.

1016

Illinois U. Coordinated Science Lab., Urbana.

EFFECTS OF ELECTRON-SURFACE INTERACTION IN IONIZATION GAUGES, by W. C. Schuemann, J. L. de Segovia, and D. Alpert. Aug. 1963 [19]p. incl. diagrs. refs. (Rept. no. R-180) (AFOSR-5495) (DA 36-039-AMC-02208(E)) AD 427830
<div align="right">Unclassified</div>

A systematic study of an anomalous nonlinearity in ionization gauges was made, indicating the magnitude of possible errors in ionization gauge readings. The errors are particularly enhanced after O_2 has been introduced into the system. Evidence was provided for interpreting the effect as due to dissociative ionization by electron impact at the grid surface. At low values of grid current, there is an enhanced rate of production of such ions accompanied by a reduced rate of collection in a Bayard-Alpert gauge.

1017

Illinois U. Coordinated Science Lab., Urbana.

THE EULER-POISSON EQUATION AND OPTIMAL LINEAR CONTROL, by R. A. Rohrer and M. Sobral. July 1963 [18]p. incl. diagr. refs. (Rept. no. R-176) (AFOSR-5496) (DA 36-039-AMC-02208(E)) AD 427076
<div align="right">Unclassified</div>

The calculus of variations is applied to the problem of finding the optimum control for a completely controllable nth order stationary linear system with quadratic performance index. A simple procedure, which involves only factoring a 2nth order even polynomial into a product of anti-Hurwitz and Hurwitz polynomials, emerges from the first variation. Moreover, an easily performed test for the sufficiency of such solutions as optimal is obtained from the second variation. Conditions under which the closed loop system is stable for the optimum control law are discussed.

1018

Illinois U. Coordinated Science Lab., Urbana.

MINIMIZATION OF ATMOSPHERIC TURBULENCE EFFECTS ON HIGH-RESOLUTION SYNTHETIC APERTURE SYSTEMS, by D. M. Diamond. Sept. 1963 [69]p. incl. diagrs. refs. (Rept. no. R-179) (AFOSR-5497) (DA 36-039-AMC-02208(E)) AD 426965
<div align="right">Unclassified</div>

A method of processing the received signals in a synthetic aperture radar system to remove the effects of atmospheric turbulence is proposed. An appropriate mathematical model of the synthetic system and the manner in which it is affected by atmospheric turbulence is developed. The model thus developed is used as the basis for a processing procedure which matches the first few terms of a Fourier series to the phase error effect caused by the atmospheric turbulence. Several examples of a computer simulation are used to illustrate the results of such processing. (Contractor's abstract)

1019

Illinois U. Coordinated Science Lab., Urbana.

A STUDY OF THE PROJECTIONS ON ELECTRODES AND THEIR EFFECT ON ELECTRICAL BREAKDOWN IN VACUUM, by H. E. Tomaschke. Jan. 1964 [109]p. incl. illus. diagrs. tables, refs. (Rept. no. R-192) (AFOSR-64-0312) (DA 36-039-AMC-02208(E)) AD 429464
<div align="right">Unclassified</div>

The present investigation was undertaken to investigate the characteristics of projections that exist on electrode surfaces and to determine the correlation between the geometry of the projections and the prebreak-down current-voltage characteristics of the electrodes. Fowler-Nordheim plots of the prebreakdown currents predicted that the projections should be of the order of 10^{-4}-10^{-5} cm in diameter and have a length about ten times the diameter. Direct observations of electrode profiles with an electron microscope confirmed that projections of the predicted size and shape did exist on the electrode surface. Electrical breakdown resulted in the disappearance of one or more projections and sometimes caused the formation of new projections.

1020

Illinois U. Coordinated Science Lab., Urbana.

OPTIMAL MATCHING OF LINEAR NETWORKS, by R. A. Rohrer. Dec. 1963 [31]p. incl. diagrs. (Rept. no. R-187) (AFOSR-64-0313) (DA 36-039-AMC-02208(E)) AD 429416
<div align="right">Unclassified</div>

Given the time domain specification for any (or any two) of the networks--the source network, the matching network, and the load network--specify the remaining network(S) so that the maximum total energy is transferred from the source to the load for arbitrary source voltages. This problem can be solved (i.e., the matching network can be specified, its realizability being an open question) in general by means of the classical calculus of variations, which yields time domain specifications for the unknown network and simple conditions which show the limitations on the applicability of the results. The further question of when the specified matching networks can actually be realized (or to what extent they can be approximated) is included.

1021

Illinois U. Coordinated Science Lab., Urbana.

AUTOMATA AND SEQUENTIAL MACHINES, A
SURVEY, by H. Y. Chang. June 1963 [42]p. incl.
diagrs. tables, refs. (Rept. no. R-168) (AFOSR-64-
0347) (DA 36-039-AMC-02208(E)) AD 420855
Unclassified

A brief study of the application of concepts of automata
theory to analysis and synthesis of sequential machines
has been made. The investigation was taken from an
engineer's viewpoint and was by no means complete.
After defining models of sequential machines, two ways
of characterizing a machine, namely, the input-output
signal set (or regular expression) method and the com-
puter program method, were indicated. The discussion
on analysis of machines was concentrated on experi-
ment-performing, a way to examine a machine's struc-
ture by merely applying inputs and observing output's
and machine decompositions. Lastly, some of the re-
sults and difficulties related to state-reduction and
state-assignment in machine synthesis procedures
were mentioned.

1022

Illinois U. Coordinated Science Lab., Urbana.

AN ALGORITHM FOR THE SYNTHESIS OF LARGE
SEQUENTIAL SWITCHING CIRCUITS, by J. Elsey.
May 1963 [53]p. incl. diagrs. tables, refs. (Rept. no.
R-169) (AFOSR-64-0599) (DA 36-039-AMC-02208(E))
AD 18163 Unclassified

This thesis develops and presents an algorithm for syn-
thesizing asynchronous sequential switching circuits.
The algorithm has certain properties which make it
useful and applicable to large switching circuits such
as the control unit of a digital computer. The steps in
the algorithm are systematic and simple permitting a
solution to be obtained in a relatively short amount of
time. The resulting design is not optimum in that the
circuit has the minimum number of states or minimum
amount of logic.

1023

Illinois U. Coordinated Science Lab., Urbana.

OF DIRECT FIXED-TIME OPTIMIZATION OF IN-
VERTIBLE SYSTEMS, by S. J. Kahne. June 1963,
65p. incl. diagrs. refs. (Rept. no. R-162) (AFOSR-
64-0600) (DA 36-039-AMC-02208(E)) Unclassified

A numerical technique for calculating the optimal con-
trol for a class of systems and constraints is de-
scribed. Nonlinear, time-varying deterministic sys-
tems subject to hard state space and hard control
space constraints are considered. Three numerical
procedures are developed to perform the optimization.
A technique for the minimization of a scalar function
of a vector variable is described where the compo-
nents of the vector are constrained by upper and lower
bounds. This minimization procedure is incorporated

in a method of constraint mapping which maps the state
space constraints into the control space. An iterative
technique for the optimization is demonstrated which
generally converges to a local minimum of the perform-
ance index.

1024

Illinois U. Coordinated Science Lab., Urbana.

NUMERICAL STUDIES OF STRONG SHOCK WAVES.
PART IV: DESCRIPTION OF 1604 PROGRAM, by J. K.
Aggarwal and B. L. Hicks. Aug. 1963 [23]p. incl.
diagrs. (Rept. no. 1-123) (AFOSR-64-0601) (DA 36-
039-AMC-02208(E)) Unclassified

The details of the program for CDC 1604 used to study
Boltzmann difference equation for a strong shock wave
are described. The main flow diagrams are shown.
The salient differences from the ILLIAC counterpart
are pointed out. (Contractor's abstract)

1025

Illinois U. Coordinated Science Lab., Urbana.

AN OPTIMIZATION TECHNIQUE FOR PULSE WIDTH
MODULATED SYSTEMS, by R. W. Kafka. May 1963,
92p. incl. diagrs. tables, refs. (Rept. no. R-163)
(AFOSR-64-0607) (DA 36-039-AMC-02208(E))
Unclassified

A procedure for the design of a controller to optimize
a certain class of pulse width modulated systems is
presented. The process to be controlled is time-in-
variant, of arbitrary order and excited by a sequence
of pulses generated from information available at arbi-
trary sampling instants. Input information to the sys-
tem is quite general and includes random and determi-
nistic phenomena. Identification of the plant is ac-
complished using state variable notation and linear es-
timation techniques. Prediction of the future plant be-
havior is also performed with these techniques and the
controller is designed to optimize the predicted plant
performance by minimizing a measure of the future
system errors. The mechanized optimal control law
or controller program, develops the pulse to be applied
at any sampling instant by specifying the pulse width
and associated sign.

1026

Illinois U. Coordinated Science Lab., Urbana.

SYNTHESIS OF SOME DISTRIBUTED RC NETWORKS,
by C. A. Hesselberth. Aug. 1963 [84]p. incl. illus.
diagrs. refs. (Rept. no. R-164) (AFOSR-64-0608)
(DA 36-039-AMC-02208(E)) AD 418171
Unclassified

A certain distributed RC structure can be used to ob-
tain rational open-circuit transfer impedances. In ad-
dition, one of the driving-point impedances turns out
to be rational. Hence, one of the open-circuit voltage
transfer functions is also rational. Furthermore, by

considering various subcircuits and distributions of resistance and capacitance it is possible to realize other rational open-circuit voltage transfer functions and rational short-circuit transfer admittances. Connecting these networks in series extends the class of functions realizable with such structures. Using a basic distributed RC network along with an external resistor and capacitor, it is possible to obtain a null in the open-circuit voltage transfer function over a certain restricted range of frequencies. However, the shape of the notch is shown graphically to be a function of the null frequency. A lossy dielectric in the distributed network is found to shift this range of frequencies upwards and alter the notch characteristics in much the same way as in the low-pass filter.

1027

Illinois U. Coordinated Science Lab., Urbana.

A NEW APPROACH TO THE SENSITIVITY PROBLEM IN MULTIVARIABLE FEEDBACK SYSTEM DESIGN, by J. B. Cruz, Jr. and W. R. Perkins. Aug. 1963 [13]p. incl. diagrs. refs. (Rept. no. R-177) (AFOSR-64-0609) (DA 36-039-AMC-02208(E)) AD 418175
Unclassified

A new point of view for the parameter variation problem in linear multivariable systems is proposed. The output deviations due to parameter variations for an open loop realization are related by a sensitivity matrix to the output deviations due to parameter variations for a closed loop (feedback) realization. By means of a performance index involving this sensitivity matrix, conditions are obtained for insuring that the feedback realization is less affected by parameter variations than an open loop realization having the same nominal transfer characteristics. A procedure based on this new sensitivity formulation is given for designing a multivariable feedback system.

1028

Illinois U. Coordinated Science Lab., Urbana.

DESIGN AND PERFORMANCE OF A POLARITY CO-INCIDENCE DETECTOR, by M. Raether and D. Bitzer. Aug. 1963 [27]p. incl. diagrs. (Rept. no. R-178) (AFOSR-64-0610) (DA 36-039-AMC-02208(E)) AD 418173
Unclassified

A synchronous detector based on the polarity coincidence principle has been constructed and tested. The theory of operation is discussed with special emphasis on the influence of correlation between samples and the influence of error sources. Details of the construction are presented and test results are discussed.

1029

Illinois U. Coordinated Science Lab., Urbana.

NONLINEAR OSCILLATIONS IN A SECOND ORDER

SYSTEM, by P. J. Ponzo. Jan. 1964 [106]p. incl. diagrs. refs. (Rept. no. R-193) (AFOSR-64-0703) (DA 36-039-AMC-02208(E)) AD 433472
Unclassified

Relaxation oscillations are investigated. A number of analytic curves are obtained which serve as upper and lower bounds on solution trajectories in this plane. In many cases, piecewise connection of such bounding curves provide annular regions within which periodic orbits lie. The number, location, stability and amplitude bounds of periodic solutions may be determined in this manner. When the method is applied to the equation of van der Pol, the upper and lower bounds obtained for the amplitude of the unique periodic solutions compare favorably with the known asymptotic expansion of the amplitude.

1030

Illinois U. Coordinated Science Lab., Urbana.

GENERAL TOPOLOGICAL ANALYSIS OF LINEAR SYSTEMS, by W.-K. Chen. Jan. 1964 [65]p. incl. diagrs. refs. (Rept. no. R-191) (AFOSR-64-0704) (DA 36-039-AMC-02208(E)) AD 433495 Unclassified

The material in this thesis can be divided into two major parts: the first part deals with methods of simplification of flow graphs, and the second part deals with general topological analysis of network determinants. It is shown that a general network determinant can be evaluated by means of directed trees and directed 2-trees. There is no sign problem. The products of such directed trees and directed 2-trees will automatically give the correct signs. Furthermore, this new method can be applied to either the node-admittance matrix or the loop-impedance matrix. Some applications of directed linear graphs, such as determining the stability of a system and inverting matrices, are also discussed. (Contractor's abstract)

1031

Illinois U. Coordinated Science Lab., Urbana.

LINEAR CONTROL LAWS FOR SINGULAR LINEAR SYSTEMS, by M. Sobral. Jan. 1964 [39]p. incl. diagr. (Rept. no. R-188) (AFOSR-64-0705) (DA 36-039-AMC-02208(E)) AD 433814 Unclassified

For a class of quadrate performance indices the optimal control law is a combination of maximum effort (bang-bang) and singular. The singular control law is linear and it is optimal in a hyperplane in the n-dimensional state-space. For practical purposes it is desirable to restrict the class of admissible control laws to be linear. This investigation presents a method of finding a linear control law which is optimal in the sense that it is the singular control law in the singular surface and the best possible linear law elsewhere. Classical calculus of variations and the more sophisticated maximum principle of Pontryagin are the mathematical tools used.

1032

Illinois U. Coordinated Science Lab., Urbana.

THE USE OF ADAPTIVE CONSTRAINED DESCENT
IN SYSTEMS DESIGN, by T. Murata. Dec. 1963 [40]p.
incl. diagrs. table. (Rept. no. R-189) (AFOSR-64-
0706) (DA 36-039-AMC-02208(E)) AD 433721
                                        Unclassified

This paper describes the application of an iterative
method, the adaptive constrained descent, to system
design where system parameters are constrained by
both upper and lower limits. The method used is es-
sentially a direct search method, not dependent on the
use of derivatives or power series approximations.
The technique insures convergence and initial guesses
can be arbitrarily chosen in some cases. This fact
makes it possible to design networks directly from
given characteristics using a high-speed digital com-
puter.

1033

Illinois U. Coordinated Science Lab., Urbana.

A MODULAR REALIZATION OF SYMMETRIC SE-
QUENTIAL MACHINES, by D. W. Rain. Doctoral
thesis, Nov. 1963 [38]p. incl. diagrs. refs. (Rept.
no. R-183) (AFOSR-64-0707) (DA 36-039-AMC-
02208(E)) AD 433821   Unclassified

A class of sequential machines which display certain
symmetries in their state diagrams is investigated
with emphasis on the cascade-parallel interconnection
of elementary, rather than arbitrarily complex,
asynchronous sequential machines. It is shown that
additional feedback around a (Huffman model) machine
may be used to eliminate certain states of the state
diagram. This feedback is restricted only in that the
delay through the feedback path must be greater than
the delay associated with the secondary variables
around which the feedback is made. Then it is shown
that interconnections of elementary modules yield ma-
chines that have symmetric state diagrams, and that
feedback may be used to create certain asymmetries.

1034

Illinois U. Coordinated Science Lab., Urbana.

A PLATO PROGRAM FOR INSTRUCTION AND DATA
COLLECTION IN MATHEMATICAL PROBLEM SOLV-
ING, by J. A. Easley, Jr., H. M. Gelder, and W. M.
Golden. Jan. 1964 [36]p. incl. illus. diagrs. (Rept.
no. R-185) (AFOSR-64-0709) (DA 36-039-AMC-
02208(E)) AD 434249   Unclassified

Solution of programming problems has been taken in
the development of a special teaching logic for the
PLATO II computer-based teaching system. This
teaching logic, called FROF, takes advantage of the
flexibility and student-controlled sequencing made
available in the laboratory or inquiry mode of program-
ming PLATO.

1035

Illinois U. Coordinated Science Lab., Urbana.

OPTIMAL LINEAR SWITCHING FOR SINGULAR LIN-
EAR SYSTEMS, by R. A. Rohrer and M. Sobral.
Mar. 1964 [28]p. incl. diagrs. refs. (Rept. no. R-196)
(AFOSR-64-0891) (DA 36-039-AMC-02208(E))
AD 435680   Unclassified

The bounded-input control of a linear, time-invariant
system with quadratic performance index is discussed
from the standpoint of simple implementation. In par-
ticular the admissible control is constrained to be a
linear function of the states fed back through a saturating
amplifier. The resulting controlled system not only ex-
hibits the usual maximum-effort mode of operation, but
also the terminal singular behavior where linear control
is in evidence.

1036

Illinois U. Coordinated Science Lab., Urbana.

OPTIMAL SINGULAR SOLUTION FOR LINEAR, MUL-
TI-INPUT SYSTEMS, by R. A. Rohrer and M. Sobral.
Apr. 1964, 21p. (Rept. no. R-199) (AFOSR-64-1114)
(DA 36-039-AMC-02208(E)) AD 601177 Unclassified

The optimal singular control for a useful class of sys-
tems was obtained. Linear, stationary systems with
multiple inputs when subject to performance indices
quadratic in the state variables, but explicitly indepen-
dent of the control variables may be optimally governed
by singular control. The means of obtaining the singu-
lar behavior and control of derived and an explicit for-
mula for the singular control is provided. (Contractor's
abstract)

1037

Illinois U. Coordinated Science Lab., Urbana.

APPLICATION OF LINEAR GRAPHS TO ELECTRICAL
NETWORKS, SWITCHING NETWORKS AND COMMU-
NICATION NETS, by W. Mayeda. Apr. 1964 [149]p.
incl. diagrs. refs. (Rept. no. R-203) (AFOSR-64-
1116) (DA 36-039-AMC-02208(E)) AD 601197
                                        Unclassified

This paper is divided into three parts: The first part
shows how linear graphs are used in analysis of elec-
trical networks. The proof for the topological formu-
las of transfer functions of passive networks without
mutual couplings given here is the first formal and
precise proof in this field. By the use of topological
formulas, such a passive network can be analyzed by a
digital computer. The second part discusses the appli-
cation of linear graphs to switching networks by start-
ing with exploration of the properties of paths in a lin-
ear graph. Then the necessity of realizing a cut set
matrix (or circuit matrix) is discussed. The third part
discusses a rather new field which is many-ports flow
problems which is called the theory of communication
nets.

1038

Illinois U. Coordinated Science Lab., Urbana.

SUPPRESSION OF NOISE EFFECTS IN PULSE WIDTH
MODULATED SYSTEMS, by H. J. Stein. Jan. 1964
[54]p. incl. diagrs. tables, refs. (Rept. no. R-190)
(AFOSR-64-1130) (DA 36-039-AMC-02208(E))
AD 437495   Unclassified

Investigation is made of a sampled data feedback sys-
tem, consisting of a lead type pulse width modulator,
a general (n-th order), linear, time-invariant plant,
and unity feedback. The closed loop system is as-
sumed to be stable, and it is assumed that plant time
constants are of the order of, or shorter than, the
pulsing period. The modulator is assumed to be im-
perfect (noisy), in that it emits pulses, the durations
of which differ from the correct values. The devia-
tion of the pulse width is assumed to be a Gaussian
random variable with zero mean and a given standard
deviation, and it is assumed that there is no correla-
tion between samples at different sampling instants.
Equations are derived which predict the probability
distribution of the plant output after any number of
sampling instants.

1039

Illinois U. Coordinated Science Lab., Urbana.

HEART RATE CORRELATES OF INSIGHT, by R. A.
Avner. Apr. 1964 [42]p. incl. tables, refs. (Rept.
no. R-198) (AFOSR-64-1132) (DA 36-039-AMC-
02208(E)) AD 600554   Unclassified

The heart rate (HR) was found to be inadequate as an
isolated intersubject correlate of mental work. It does
not appear that reliable specific patterns will be found as
long as respiration effects force use of procedures
which cause uncertainty of HR-change identification.
A possible answer to this problem would be a recording
method by which respiration changes were used to ad-
just automatically for respiration effects in HR. Be-
tween the extremes of threat of physical punishment
and what is essentially a vigilance task, there might
be other situations in which insight leads to reliable
HR patterns. Until effects of respiration on HR are
eliminated, the possibility is small of finding reliable
patterns more subtle than a large step function.

1040

Illinois U. Coordinated Science Lab., Urbana.

SELF-DIRECTED INQUIRY IN CLINICAL NURSING
INSTRUCTION BY MEANS OF THE PLATO SIMU-
LATED LABORATORY, by M. Bitzer. Dec. 1963
[66]p. incl. illus. diagrs. tables. (Rept. no. R-184)
(AFOSR-64-1359) (DA 36-039-AMC-02208(E))
AD 437586   Unclassified

A portion of a medical-surgical nursing study unit was
programmed for use on the PLATO system. It was
presented to a group of student nurses, six students
obtaining information by self-directed inquiry in the

PLATO simulated laboratory and seven students in the
control group attending their regular class with regu-
lar instructor. The experimental and control groups
did not differ significantly on a pre-test of subject mat-
ter knowledge. A comparison of post-test results
showed a difference in favor of the PLATO group that
was significant at the .09 level.

1041

Illinois U. Coordinated Science Lab., Urbana.

ELECTRON COLLISIONS IN NEON PLASMA, by C. L.
Chen. Apr. 1964 [21]p. incl. diagrs. table, refs.
(Rept. no. R-201) (AFOSR-64-1360) (DA 36-039-
AMC-02208(E)) AD 439438   Unclassified

The momentum transfer collision frequencies of elec-
trons with neon ions and neutral atoms were measured
in a decaying neon plasma over the temperature range
from 200 to 600°K. The temperature-density depen-
dence of the electron-ion collision frequency and the
energy dependence of the momentum transfer cross sec-
tions of electrons with neon atoms was determined.

1042

Illinois U. Coordinated Science Lab., Urbana.

SPIN RELAXATION OF OPTICALLY PUMPED CESI-
UM, by F. A. Franz. Doctoral thesis, Apr. 1964
[99]p. incl. diagrs. tables, refs. (Rept. no. R-202)
(AFOSR-64-1361) (DA 36-039-AMC-02208(E))
AD 439436   Unclassified

Spin relaxation of optically pumped cesium vapor has
been measured as a function of buffer gas pressure for
various inert gases. Disorientation cross sections
have been found to be 5.3×10^{-24} cm^2 for neon, $8.0 \times
10^{-23}$ cm^2 for argon, 2.1×10^{-21} cm^2 for krypton,
and 4.6×10^{-20} cm^2 for xenon. The diffusion coefficients
of cesium in neon and argon were found to be 0.40
cm^2/sec and 0.23 cm^2/sec, respectively. Disorienta-
tion cross sections and diffusion coefficients have also
been determined for molecular nitrogen. The results
are $\sigma = 4.7 \times 10^{-23}$ cm^2, $D_0 = 0.22$ cm^2/sec for N$_2{}^{14}$;
$\sigma = 5.3 \times 10^{-23}$ cm^2, $D_0 = 0.20$ cm^2/sec for N$_2{}^{15}$.
The agreement of these values with existing theory is
discussed. (Contractor's abstract)

1043

Illinois U. Coordinated Science Lab., Urbana.

DETECTION OF RATE CHANGES IN PERIODIC PHE-
NOMENA, by R. A. Avner. Oct. 1964, 15p. incl.
tables. (Rept. no. R-235) (AFOSR-65-0251) (DA 36-
039-AMC-02208(E)) AD 609698   Unclassified

The objective of this paper is to show with what proba-
bility differences between numbers of observed events
within a pair of time intervals may be ascribed to
specified changes in rate of a periodic phenomenon.

In the example given above it might be required to say with what probability the observed difference of (25 - 10) = 15 events might be ascribed to an actual rate change of 0, 5, 10, 12, etc., events per interval. Such measures are valid for the class of phenomena, such as human heart rate, for which magnitude of rate change is relatively unrelated to base rate.

1044

Illinois U. Coordinated Science Lab., Urbana.

DYNAMIC STABILITY OF THE RESONANT CIRCUIT ELECTRICALLY SUPPORTED GYRO, by D. R. Allen. Aug. 1963 [46]p. incl. diagrs. (Rept. no. R-166) (AFOSR-5494) (DA 36-039-sc-85122) AD 427032
Unclassified

The electrically supported gyro is a free, two-axis gyro which employs a spherical metal rotor, shielded from stray magnetic fields and supported without physical contact in ultra-high vacuum by servo-controlled high-voltage electric fields. The rotor is initially accelerated by induction motor techniques but spins freely with virtually no friction during gyro operation. An analysis is made of the static and dynamic properties of a unique rotor support servo called the resonant-support servo. Because the resonant-support servo is dynamically unstable, three general methods of stabilizing the servo are described and analyzed.

1045

Illinois U. [Dept. of Chemistry] Urbana.

A STUDY OF METAL ALKYLS, by T. L. Brown. Final rept. Mar. 1, 1963 4p. (AFOSR-4621) (AF 49(638)466) AD 454654 Unclassified

The research described in this final report has been concerned principally with the properties of so-called electron-deficient metal alkyls. These compounds are characterized by unusual molecular structures, in which certain elements exhibit bonding to neighbor atoms in greater number than the number of electrons originally available for bonding. One therefore speaks of multi-center bonds, in which a single electron pair serves to bond more than two nuclear centers. Attention has been concentrated upon organolithium compounds, with some work being done on two other organometal systems of interest.

1046

Illinois U. Dept. of Chemistry, Urbana.

A SHOCK TUBE WITH QUADRUPOLE MASS FILTER FOR MONITORING HIGH-TEMPERATURE REACTION KINETICS, by D. Gutman, A. J. Hay, and R. L. Belford. Interim rept. Jan. 1, 1962-Sept. 1, 1964, 46p. incl. illus. diagrs. (Research rept. no. 1) (AFOSR-64-2410) (AF AFOSR-62-245 and AF AFOSR-64-588) AD 609775 Unclassified

During the term of these grants, all the equipment

necessary to study fast chemical reactions with a shock tube and mass spectrometer were built. All the separate components were assembled, tested and in most cases modified to improve performance. Preliminary test results were obtained in the form of ion current-vs -time curves for shocked pure argon and for dilute N_2 in Ar. A preliminary test of the N_2O dissociation reaction was performed. Several new ideas in shock tube instrumentation were developed and are discussed in Section 2. The shock studies in the nonreacting systems were conducted to calibrate the system and also to determine the limits of sensitivity and range of applicability of this method of studying reactions. Some of the early results are discussed in Section 3. Some observations based on the work to date and plans for continuation are discussed briefly in section 4.

1047

Illinois U. [Dept. of Mathematics] Urbana.

SOME IMPLICATIONS OF THE GENERALIZED GAUSS-BONNET THEOREM, by R. L. Bishop and S. I. Goldberg. [1964] [28]p. (AFOSR-4817) (AF AFOSR-62-129) AD 453835 Unclassified

Also published in Trans. Amer. Math. Soc., v. 112: 508-535, Sept. 1964.

One of the most significant aspects of differential geometry is that which deals with the relationship between the curvature properties of a Riemannian manifold M and its topological structure. One of the results in this connection is the (generalized) Gauss-Bonnet theorem which relates the curvature of compact and oriented even-dimensional manifolds with an important topological invariant, viz., the Euler-Poincare characteristic. In the 2-dimensional case, the sign of the Gaussian curvature determines the sign of the characteristic. Moreover, if the Gaussian curvature vanishes identically, so does the characteristic. In higher dimensions, the Gauss-Bonnet formula is not so simple; this aspect is discussed.

1048

Illinois U. [Dept. of Mathematics] Urbana.

ON THE TOPOLOGY OF POSITIVELY CURVED KAEHLER MANIFOLDS, by R. L. Bishop and S. I. Goldberg. [1963] [6]p. (AFOSR-64-1617) (AF AFOSR-62-129) AD 446886 Unclassified

Also published in Tohoku Math. Jour., v. 15: 359-364, Dec. 1963.

Theorem: A complete holomorphically pinching Kaehler manifold with holomorphic pinching >11/13 has the homotopy type of complex projective space. It is the purpose of this paper to improve the bounds thereby resulting in a corresponding improvement of the constant 11/13 in the above theorem. In fact, it is shown that the bounds obtained are the best possible that can be derived by considering only the algebra of the curvature tensor (at one point). The main result is the following: A complete holomorphically pinched

Kaehler manifold with holomorphic pinching >4/5
has the homotopy type of complex projective space.

1049

Illinois U. [Dept. of Mathematics] Urbana.

A COMPLEX-VARIABLES PROOF OF HÖLDER'S
INEQUALITY, by L. A. Rubel. [1964] [1]p. (AFOSR-
65-1409) (AF AFOSR-63-460) AD 622638
Unclassified

Also published in Proc. Amer. Math. Soc., v. 15:
999, Dec. 1964.

A complex-variables proof is presented for Hölder's
inequality which states that if $f, g \geq 0$, if $p > 1$, and if
$1/p + 1/q = 1$, then $\int fg \leq \{\int fp\}^{1/p} \{\int g^q\}^{1/q}$. Replac-
ing f^p by f and g^q by g, and writing $1/q = s$, it is proved
that $\emptyset(s) \leq 1$ for $0 < s < 1$, where $\emptyset(s) = \int f^{1-s}g^s /$
$\{\int f\}^{1-s}\{\int g\}^s$. Proof involves the maximum modulus
principle.

1050

Illinois U. [Dept. of Mathematics] Urbana.

BOUNDED APPROXIMATION BY POLYNOMIALS, by
L. A. Rubel and A. L. Shields. [1964] [18]p. incl.
diagrs. (AFOSR-65-1410) (AF AFOSR-63-460)
AD 621641   Unclassified

Also published in Acta Math., v. 112: 145-162, Dec. 2,
1964.

For an arbitrary bounded open set G in the complex
plane, consideration is given to the problem of which
functions in G can be obtained as the bounded point-
wise limits of polynomials in G. Roughly the answer is
that a function is such a limit if and only if it has a
bounded analytic continuation throughout a certain
bounded open set G* that contains G. The major por-
tion of the paper is spent in establishing the following
theorem: Let G be a bounded open set in the plane
and let f be a bounded analytic function in G. If there
is a function F, analytic in G* and agreeing with f in
G, with $|F(z)| \leq M$ in G*, then there is a sequence of
polynomials $\{p_n\}$ such that (1) $\lim p_n(z) = F(z)$ $(z \in G^*)$
(2) $|p_n(z)| \leq M$ $(z \in G^*; n = 1, 2, ...)$. Conversely, if
there is a sequence of polynomials converging to f at
each point of G, and uniformly bounded in G, then
there is a bounded analytic function F in G* that agrees
with f in G.

1051

Illinois U. [Dept. of Mathematics] Urbana.

BOUNDED APPROXIMATION BY POLYNOMIALS, by
L. A. Rubel and A. L. Shields. [1963] [3]p. (AFOSR-
65-1413) (AF AFOSR-63-460) AD 621259
Unclassified

Also published in Bull. Amer. Math. Soc., v. 69:
591-593, July 1963.

For an arbitrary bounded open set in the complex plane,
the problem is considered of which complex-valued
functions in the set can be obtained as the bounded
pointwise limits of a sequence of polynomials. The fol-
lowing theorem is presented: Given an arbitrary bounded
open set G in the complex plane, and a complex-valued
function f defined on G. There exists a sequence $\{p_n\}$
of polynomials that are uniformly bounded on G and that
converge pointwise on G to f and only if f has an exten-
sion F that is bounded and holomorphic on G*, where
G* is the inside of the outer boundary of G. Since the
proof for the general case is long and complicated,
only the proof for the special case when G is connected
is presented.

1052

Illinois U. [Dept. of Mathematics] Urbana.

ON SEPARATION BY HARMONIC FUNCTIONS, by L.
A. Rubel. [1963] [6]p. (AFOSR-65-2599) (AF AFOSR-
63-460) AD 627946   Unclassified

Also published in Acta Math., v. 15: 175-176, 1964.

The paper concerns the following question which was
posed to many mathematicians, among them some ex-
perts in potential theory: For which values of n is the
following statement true. If f is a superharmonic func-
tion on Euclidean space E (n), h a subharmonic func-
tion there, and $f < $ or $= h$ everywhere, then there ex-
ists a harmonic function g such that $f <$ or $= g <$ or $= h$
everywhere. The answer is that the statement holds
only for n = 1, where it becomes the familiar assertion
that a concave function f that lies below a convex func-
tion h may be separated from h by a linear function g.

1053

Illinois U. Dept. of Mathematics, Urbana.

TAUBERIAN THEOREMS FOR SUM SETS, by P. Erdos,
B. Gordon and others. [1963] [13]p. (AFOSR-65-2640)
(AF AFOSR-63-460) AD 627948   Unclassified

Also published in Acta Arith., v. 9: 177-189, 1964.

The sums formed from the set of non-negative powers
of 2 are just the non-negative integers. It is easy to
obtain "abelian" results to the effect that if a set is
distributed like the powers of 2, then the sum set will
be distributed like the non-negative integers. This pa-
per is concerned with converse, or "Tauberian" re-
sults. The main theme is the following question: if the
set of sums formed from a given set of positive real
numbers resembles an arithmetic progression, how
much must the original set resemble a set of constant
multiples of powers of 2?

1054

Illinois U. [Dept. of Mining, Metallurgical and Petroleum Engineering] Urbana.

DISLOCATION DAMPING IN SEMICONDUCTORS AND ABRUPT VERSUS SMOOTH KINKS, by T. Ninomiya, R. Thomson, and F. Garcia-Moliner. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0797) (AF AFOSR-62-179) AD 616633　Unclassified

Also published in Jour. Appl. Phys., v. 35: 3607-3613, Dec. 1964.

A previous dragging point model of dislocation mobility is modified and applied to the dislocation damping data in Si and Ge. The motion of built-in kinks along a dislocation is considered to be responsible for the damping. In contrast to the abrupt kink model, the free motion of the kinks is impeded by the dragging points. The predictions of this model are compared with those made on the basis of the abrupt kink model, with regard to (a) damping, (b) estimated kink width, and (c) dislocation mobility. The dragging-point model seems to give a more consistent picture, although direct experimental verification of the presence of dragging points is not yet available. An improved table of derived parameters for the dragging-point theory of dislocation mobility is given based on additional information from damping measurements in Ge.

1055

Illinois U. Dept. of Mining, Metallurgical and Petroleum Engineering, Urbana.

DIFFUSION OF OXYGEN AND NITROGEN BETWEEN SPECIAL INTERSTITIAL SITES IN SOLID SOLUTION IN YTTERBIUM, by G. Mah and C. Wert. [1964] [4]p. incl. diagrs. (AFOSR-64-0443) (AF AFOSR-62-192) AD 436175　Unclassified

Also published in Trans. Metall. Soc. AIME, v. 230: 16-19, Feb. 1964.

Internal-friction peaks caused by diffusion of oxygen and nitrogen have been observed in ytterbium. They are thought to be caused by the redistribution, under stress, of strain dipole around an interstitial oxygen or nitrogen and a neighboring substitutional impurity. With the use of a simple geometrical model, diffusion coefficients for oxygen and nitrogen between special interstitial sites have been calculated.

1056

Illinois U. [Dept. of Mining, Metallurgical and Petroleum Engineering] Urbana.

DIFFUSION OF GASES IN SPECIAL INTERSTITIAL SITES IN HAFNIUM, by E. Bisogni, G. Mah, and C. Wert. [1964] [6]p. (AFOSR-64-2447) (AF AFOSR-62-192) AD 453615　Unclassified

Also published in Jour. Less Common Metals, v. 7: 197-204, 1964.

Both nitrogen and oxygen have been found to cause internal friction peaks to appear in reactor-grade Hf. The mechanism of the peak is discussed in terms of redistribution of strain dipoles formed by the interstitial impurity atoms with the substitutional impurity atoms. The diffusion coefficients were calculated from a simple two position model.

1057

Illinois U. Dept. of Mining, Metallurgical and Petroleum Engineering, Urbana.

HIGH TEMPERATURE NUCLEAR MAGNETIC RESONANCE PROBE, by R. L. Odle and C. P. Flynn. [1964] [2]p. incl. diagrs. (AFOSR-65-0796) (AF AFOSR-62-192) AD 616208　Unclassified

Also published in Rev. Scient. Instr., v. 35: 1611-1612, Nov. 1964.

An r-f probe was developed which is simple, rugged, and capable of operating at a considerably high temperature, i.e., 1300°C. The probe assembly consists of 2 basic parts: (1) a ceramic coil former, which contains the sample chamber and (2) a stainless steel shield enclosing the coil former. A thermocouple passes through a hole in the shield and into the coil former, thereby allowing the specimen temperature to be monitored during an experiment.

1056

Illinois U. [Dept. of Physics] Urbana.

RADIOTRACER STUDIES OF GOLD ADSORPTION AND DESORPTION ON CLEAN MOLYBDENUM SURFACES, by E. von Goeler and E. Lüscher. [1963] [5]p. incl. diagrs. table. (AFOSR-J1555) (AF 16(603)49) AD 427403　Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 1217-1221, 1963.

The adsorption and desorption of gold on heat-cleaned surfaces of polycrystalline molybdenum was studied at a residual gas pressure of 2×10^{-9} torr. A radiotracer method was used in a differential pumping system. The sticking coefficient was measured to be s = 0.99 ± 0.01 at beam densities up to 10^{11} particles/cm^2 sec. The desorption probability per unit time was found to obey a relation $w = w_0 \exp(-E/kT)$ with $w_0 = 2 \cdot 10^{13}$ sec^{-1} and E = 4.2 ± 0.2 ev. (Contractor's abstract)

1059

Illinois U. [Dept. of Physics] Urbana.

MAGNETOCONDUCTIVITY AND POLAR SCATTERING IN MODERATELY IONIC CRYSTALS, by F. Garcia-Moliner. [1963] [12]p. (AFOSR-J1101) (AF 49(636)-526) AD 420773　Unclassified

Also published in Phys. Rev., v. 130: 2290-2301, June 15, 1963.

The dc transport problem in a polar crystal, in the range of optical mode scattering, is studied within a weak-coupling model for the electron-phonon interaction. A full variational calculation is performed in the presence of a magnetic field and carried out to high accuracy on a digital computer. It is stressed that the physical effects should be discussed in 'magnetoconductivity,' rather than conventional 'magnetoresistivity' terms, corresponding to the type of experimental arrangement frequently used for these materials. The model, which is, in principle, restricted to a small coupling constant ($\alpha \ll 1$), has some interesting dispersive properties and is used as a working tool for an over-all picture of the transport problem in its full complexity, when a magnetic field is present.

1060

Illinois U. Dept. of Physics, Urbana.

HIGH-TEMPERATURE DIELECTRIC CONSTANT OF POTASSIUM CHLORIDE, by P. V. Sastry and T. M. Srinivasan. [1963] [5]p. incl. diagrs. refs. (AFOSR-64-0751) (AF 49(638)529) AD 436492   Unclassified

Also published in Phys. Rev., v. 132: 2445-2449, Dec. 15, 1963.

A dispersion of the dielectric constant of zone-purified potassium chloride has been observed at temperatures above 650°C and in the frequency range between one and ten mc/sec. The data are interpreted in terms of the Debye equations and the assumption that the dipoles are vacancy pairs. The activation energy for reorientation of a vacancy pair is found to be 1.04 ev and the heat of formation of a vacancy pair is found to be 1.34 ev. These quantities have been calculated by Tharmalingam and Lidlard as 1.15 and 1.28 ev, respectively. The dielectric data yield an absolute number of vacancy pairs that is at least a factor of ten larger than is acceptable.

1061

Illinois U. [Dept. of Physics] Urbana.

Z_2 AND Z_3 COLOR CENTERS IN KCl AND KBr, by H. Ohkura. [1964] [6]p. (AFOSR-64-2526) (AF 49-(638)529) AD 453826   Unclassified

Also published in Phys. Rev., v. 136: A446-A451, Oct. 19, 1964.

The optical and electron-spin-resonance properties of potassium-chloride and -bromide crystals which contain divalent strontium ions have been examined. The conversion of the Z_2 optical absorption band into the Z_3 band has been studied and two new absorption bands have been discovered. One of these bands, the S band, appears to be due to optical transitions to excited states of the Z_2 center which lie above the excited state responsible for the Z_2 band. The second band, the Z_3 band, is interpreted as an exciton absorption band associated with the Z_3 center.

1062

Illinois U. Dept. of Physics, Urbana.

SOLID STATE AND NUCLEAR RESULTS FROM MÖSSBAUER STUDIES WITH I^{129}, by D. W. Hafemeister, G. DePasquali, and H. deWaard. [1964] [13]p. incl. diagrs. tables, refs. (AFOSR-65-0772) (AF 49(638)1048) AD 616037   Unclassified

Also published in Phys. Rev., v. 135: B1089-B1101, Sept. 7, 1964.

In this note the Mössbauer effect of the 26.8-kev transition in I^{129} is studied in a number of iodine compounds with the following results: The isomeric shifts for the alkali iodides are found to be linearly dependent on the number of 5p holes in the iodine ion. From this discrepancy, a calibration of the isomeric shift scale in terms of the 5s-electron density is obtained, and from this calibration a relative change of nuclear radius is computed. The isomeric shifts for some iodates indicate that their 5s-electron density has increased 18% over that of iodides, which is caused by the partial removal of 5p electrons from iodine in the I-O bonds resulting in reduced screening of the 5s electrons. The quadrupole splitting of KIO_3 was used to determine the I^{129} quadrupole ratio, $Q_{26.8}/Q_{gnd} = 1.23 \pm 0.02$, and the recoilless fraction f was found to deviate from 0.26 by less than 25% for all alkali iodides at 80°K.

1063

Illinois U. Dept. of Physics, Urbana.

LIFETIME OF THE EXCITED F_A CENTER, by G. Spinolo and F. C. Brown. [1964] [5]p. incl. diagrs. table, refs. (AFOSR-64-2390) (AF AFOSR-62-215) AD 453615   Unclassified

Also published in Phys. Rev., v. 135: A450-A454, July 20, 1964.

Recent experimental results show that the radiative lifetime of the F center is as long as 0.58 μsec in KCl and 1.1 μsec in KBr. Similar pulsed luminescence and photoconductivity measurements are reported on the F_A center in KCl and KBr.

1064

Illinois U. Dept. of Physics, Urbana.

ELECTRON HALL MOBILITY IN THE ALKALI HALIDES, by R. K. Ahrenkiel and F. C. Brown. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0800) (AF AFOSR-62-215) AD 616210   Unclassified

Also published in Phys. Rev., v. 136: A223-A231, Oct. 5, 1964.

New results are presented on the mobility of electrons in alkali-halide crystals down to the temperature of liquid helium. An improved technique was used to observe the transient Hall effect for electrons released from color centers by light. Optical-mode scattering with mobility dependent upon $\exp(\Theta/T)$ was generally observed above 40°K. The Debye temperature Θ can be compared with the optical-mode frequency of the material, whereas the magnitude of the scattering can be used to estimate band and polaron mass parameters. Mobilities as high as 15,000 cm^2/v-sec, depending upon F-center density, were observed for lightly colored crystals of KBr at 7°K. Similar high mobilities were found for KI and a sample of zone-refined KCl, but the largest mobility observed in NaCl was 1200 cm^2/v-sec. The low-temperature mobility in KBr could be reduced an order of magnitude by optically converting F centers to F' and α centers. The original mobility could then be restored by illumination in the F' band at low temperature.

1065

Illinois U. [Dept. of Physics] Urbana.

A NEW CATALOGUE OF EARTHQUAKE FAULT PLANE SOLUTIONS, by H. D. Fara. [1964] [27]p. (AF AFOSR-62-419) AD 451385   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1491-1517, Oct. 1964.

The earthquake fault plane solutions available to spring, 1964 in the literature are listed in standard form.

1066

Illinois U. [Dept. of Physics] Urbana.

ON THE POSSIBILITY OF THE SEISMIC DETECTION OF EXPLOSIONS FROM THE SIGNS OF FIRST ON-SETS, by A. E. Scheidegger. [1964] [7]p. (AF AFOSR-62-419) AD 451386   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1529-1535, Oct. 1964.

It is shown that, for an earthquake region, critical areas can be derived, inside which one would expect seismic stations to observe a dilatation in the first onsets. Thus, if compressions are observed inside the critical area, one has grounds for the assumption that the earthquake was an explosion. As an example, critical areas are calculated for Turkmenia and the Tien Shan region.

1067

Illinois U. [Dept. of Physics] Urbana.

A SPECIALIZED TYPE OF SEISMIC RESEARCH, by

A. E. Scheidegger. Final rept. Sept. 1, 1962-Dec. 1, 1964, 40p. (AF AFOSR-62-419) AD 608466
Unclassified

The aim of the research project was to investigate the relation of the mechanism of natural seismic foci to the prevailing tectonic stress field in an area. After the determination of this relation, a criterion for distinguishing natural seismic shocks from explosions was to be established. The stages of the investigations were the following: (1) The possible theoretical relationships between focal mechanisms and tectonic stresses were analyzed, (2) The data of focal mechanisms ('fault plane solutions') available in the literature were collected and tabulated in a uniform fashion, (3) The best statistical means for averaging the various parameters of fault plane solutions of earthquakes were developed, (4) The statistical connection between focal mechanisms and the tectonic stress field was established, and (5) A criterion for distinguishing seismic from artificial shocks was proposed.

1068

Illinois U. [Dept. of Physics] Urbana.

THE TECTONIC STRESS AND TECTONIC MOTION DIRECTION IN EUROPE AND WESTERN ASIA AS CALCULATED FROM EARTHQUAKE FAULT PLANE SOLUTIONS, by A. E. Scheidegger. [1964] [10]p. (AF AFOSR-62-419) AD 451390   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1519-1528, Oct. 1964.

The statistics of fault plane solutions of earthquakes is further analyzed and it is shown that, to find a best axis or best plane to a set of axes, the eigenvectors of a certain matrix must be calculated. The justification for this procedure follows from the same argument as that of Fisher who showed that the best of a series of directions is obtained by forming the vector sum. The eigenvector technique is then applied to the pertinent axes of fault plane solutions of earthquakes that occurred in Europe and Western Asia. It is shown that, in this region, the local mechanisms of the earthquakes tend to orient themselves in such a fashion that the P axes coincide with the principal horizontal stress directions, the latter being normal to the geographically prominent features.

1069

Illinois U. Dept. of Physics, Urbana.

NON-OHMIC TRANSPORT IN SEMICONDUCTORS IN A MAGNETIC FIELD, by D. Matz and F. Garcia-Moliner. [1964] [15]p. (AFOSR-64-1782) (AF AFOSR-63-326) AD 449074   Unclassified

Also published in Phys. Stat. Solidi, v. 5: 495-509, 1964.

Shockley's hot electron picture for semiconductors in high electric fields is extended to include arbitrary (though "non-quantizing") magnetic fields. The effects

are then more diversified and offer wider experimental possibilities. While preserving the original simplicity of Shockley's model, its scope can be extended by including a reduction of the power input due to the deflection caused by the Lorentz force. Explicit calculations are carried out for an idealized isotropic model which Conwell used to interpret the experimental data for n-Ge in zero magnetic field. This involves interactions of electrons with acoustic and covalent optical modes. This model calculation is designed to illustrate the main physical features of an extended Shockley picture. The results here derived are discussed from the point of view of the planning and analysis of experimental investigations which may bear on the subject.

1070

Illinois U. Dept. of Physics, Urbana.

WARM-CARRIER RESISTIVITY IN IMPURE N-InSb IN A MAGNETIC FIELD, by D. Matz and F. Garcia-Moliner. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-0161) (AF AFOSR-63-326) AD 611621
Unclassified

Also published in Phys. Stat. Sol., v. 7: 205-222, 1964.

The influence of a transverse magnetic field on the warm carrier behavior of the conductivity and resistivity is studied for different scattering mechanisms. An electron temperature model of the Shockley type is used throughout. For a calculation of the conductivity, the coefficient Beta of the quadratic deviation from Ohm's law vanishes in high magnetic fields. For a calculation of the resistivity it saturates to a constant value (not including quantization). Only for polar optical scattering at low temperatures the saturation value has opposite sign to that of Beta in a low magnetic field. The theory is applied to some resistivity measurements in impure n-InSb at $77°K$. It is concluded that these can be essentially explained by a combination of polar optical scattering and ionized impurity scattering.

1071

Illinois U. [Dept. of Psychology] Urbana.

INTERACTION PROCESS AND TASK OUTCOME IN EXPERIMENTALLY-CREATED NEGOTIATION GROUPS, by J. E. McGrath and J. W. Julian. [1963] [22]p. incl. refs. (AFOSR-65-2174) (AF AFOSR-63-69) AD 625568
Unclassified

Also published in Jour. Psychol. Studies, v. 14: 117-138, 1963.

Data were obtained from 60 experimentally-created, four-person negotiation groups. Each consisted of one representative from each of three campus religious foundations plus a graduate student who served as nonpartisan chairman. Each negotiation group was required to develop unanimous agreement on its proposed solution to a socio-political topic on which the foundations held sharply contrasting views. The study

focused on analyses of the negotiation process and investigation of relationships between the negotiation process and measures of negotiation effectiveness.

1072

Illinois U. [Dept. of Psychology] Urbana.

MEDIATION AND FORGETTING, by J. A. Adams. [1964] [10]p. (AFOSR-64-1162) (AF AFOSR-63-135) AD 442845
Unclassified

Also published in Psychol. Repts., v. 14: 591-600, 1964.

An experiment was performed to test the hypothesis that the presence of mediation reduces verbal forgetting. During original learning experimental groups acquired two classes of multiple mediators that intervened between the stimulus and response members of a paired-associate list (A-C). An AB-BC-AC paradigm was used for experimental groups. Control groups did not have the mediators and simply learned the A-C list. All groups recalled the A-C list after either three or seven days. There were 20 Ss in each group. Experimental groups were not found superior to control groups in recall, as hypothesized. One type of mediation actually produced retention inferior to that of control groups.

1073

Illinois U. [Electrical Engineering Research Lab.] Urbana.

ELECTRICAL CONDUCTIVITY OF POTASSIUM CHLORIDE, by L. Y. Wei. [1963] [5]p. (AFOSR-64-2098) (AF 49(638)417) AD 451344
Unclassified

Also published in Jour. Chem. Phys., v. 39: 2709-2713, Nov. 1963.

Potassium was evaporated onto a KCl crystal at $77°K$ under a vacuum of 10^{-9} Torr. Conductivity measurements were made before and after the film was annealed at room temperature. For the stable film, Ohm's law is obeyed up to about 25 v/cm. The preannealed film became very unstable in a field near 250 v/cm and the current-voltage relation is nonlinear. The experimental results strongly suggest that in the stable film, the conduction is by the mechanism of impurity conduction subject to the Schottky effect while in the unsettled film, the currents, though mainly carried by electrons, are decisively controlled by mobile ions.

1074

Illinois U. [Electrical Engineering Research Lab.] Urbana.

A MICROWAVE FREQUENCY DYNAMIC CROSSED-FIELD PHOTOMULTIPLIER, by O. L. Gaddy and D. F. Holshouser. [1963] [10]p. incl. illus. diagrs. refs. (AFOSR-J371) (AF AFOSR-62-250) AD 407328
Unclassified

Also published in Proc. IEEE, v. 51: 153-182, Jan. 1963.

A new type dynamic secondary emission electron multiplication system is described which possesses the advantages of electrostatic electron multipliers while overcoming their major disadvantage, i.e., loss of gain at high frequencies due to electron transit time dispersion. In the dynamic crossed-field electron multiplication system, electrons are multiplied in a field configuration consisting of a high-frequency electric field and a crossed steady magnetic field near a single secondary emitting electrode. The analysis of the system is presented, and an experimental photomultiplier device is described which utilizes this principle.

1075

Illinois U. [Electrical Engineering Research Lab.]
Urbana.

AN INTERNALLY REFLECTING OPTICAL RESONATOR WITH CONFOCAL PROPERTIES, by D. F. Holshouser. [1963] [6]p. incl. illus. diagrs. (AFOSR-65-0436) (AF AFOSR-62-250) AD 612316
Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 1: 1453-1456, 1964.

A confocal system is defined as an optical resonator using spherical mirrors; advantages of the confocal system over the planar mirror are that the diffraction losses for the former can be much lower and its alignment is less critical. The confocal resonator has the following basic properties: (1) a ray leaving one mirror at the axis is reflected back to that point by the opposing mirror after a single reflection; (2) a ray parallel to the axis leaves one mirror and returns to that point after three reflections; and (3) the path length for a complete transit of any ray leaving the axis at one mirror is independent of the ray angle. A configuration for such a confocal resonator is derived mathematically; with it confocal properties may be obtained without reflecting coatings. A semi-confocal optical maser was fabricated from a 50-mm-long, 6-mm-diameter cylindrical rod with one ground end and one coated to give a few percent transmission. The material was Schott barium crown glass doped with neodymium. Stimulated emission was obtained, and threshold input energy at room temperature was less than for a planar ruby of the same dimensions.

1076

Illinois U. [Electrical Engineering Research Lab.]
Urbana.

MICROWAVE AND ELECTRO-OPTICAL PROPERTIES OF CARBON DISULFIDE, by O. L. Gaddy, D. F. Holshouser, and R. E. Stanfield. [1964] [6]p. incl. illus. diagrs. (AFOSR-65-0439) (AF AFOSR-62-250) AD 612314
Unclassified

Also published in Proc. Third Internat'l. Cong. on Quantum Electronics, Paris (France) (Feb. 11-15, 1963), v. 2: 1679-1686, 1964.

Carbon disulfide is an excellent microwave dielectric, whose Kerr constant and breakdown can be enhanced by cooling. The microwave power required in a parallel-plane travelling wave Kerr cell is limited at 3 Gc by the conductor losses rather than by the dielectric losses. On the basis of the calculations and experimental results, it appears that a Kerr cell no longer than one meter could provide continuous and complete light modulation with microwave power less than 25 watts. Carbon disulfide has the rather obvious advantages over solid-state materials in that it is much easier to pour liquid out of a bottle than to grow a nearly perfect crystal, and the nonuniform birefringence produced by dielectric loss induced temperature gradients is less of a problem with a liquid.

1077

Illinois U. [Electrical Engineering Research Lab.]
Urbana.

PHOTOMULTIPLICATION WITH MICROWAVE RESPONSE, by O. L. Gaddy and D. F. Holshouser. [1964] [6]p. incl. illus. diagr. (AFOSR-65-0440) (AF AFOSR-62-250) AD 612315
Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 1: 1717-1722, 1964.

In this paper, some recent results of an investigation of a new kind of photomultiplier which is capable of microwave response are presented. In this method of amplification, called dynamic crossed-field electron multiplication (DCFEM), the energy for electron multiplication is obtained from a microwave electric field rather than an electrostatic field, and the multiplication takes place upon a single secondary emitting electrode. This method provides a rigid control of electron transit time through phase focusing thereby making possible a large amplification of weak photoelectron currents varying at microwave rates.

1076

Illinois U. [Electrical Engineering Research Lab.]
Urbana.

STIMULATED EMISSION IN THE SUBMILLIMETER REGION, by R. J. Strain and P. D. Coleman. [1963] [21]p. incl. diagrs. (AFOSR-4774) (AF AFOSR-62-267) AD 406391
Unclassified

Presented at Orlando Millimeter and Submillimeter Conf., Jan. 9, 1963.

It is proposed that the exchange coupled pairs of chromium in dark ruby represent a potent system for the realization of a maser in the submillimeter region. The greatest strength of this system is the fact that it may be pumped with broadband light. The feasibility of this system is substantiated by an approximate analysis of

of the white light pumping cycle. The experiment used to observe the transitions is an optical pumping experiment, because scattered light is used as an indicator of microwave activity. It differs from conventional optical pumping in the use of low temperature rather than pumping to establish the initial conditions, and the use of microwave thermal radiation to disturb this condition. Since a cavity is used in the microwave circuit, the resolution is high, and the results indicate the line widths of the submillimeter transitions.

1079

Illinois U. [Electrical Engineering Research Lab.] Urbana.

LOGICAL STRUCTURE OF ENVIRONMENT AND ITS INTERNAL REPRESENTATION, by H. von Foerster. [1963] [12]p. (AFOSR-J1542) (AF AFOSR-63-7) AD 427409   Unclassified

Also published in Proc. Internat'l. Design Conf., Aspen, Colo., 1962, Zeeland, Herman Miller, Inc., 1963.

A discussion is presented of the structure of the optimum environment of man. The analysis is developed in terms of game theory where man is faced with decision-making under insufficient information as to the unpredictable forces of nature. It is concluded that a coalition structure is much stronger than a competitive structure where the "whole is more than the sum of its parts". When the parts are interacting in the form of a superadditive composition, the logical structure of environment is a triple interaction between at least two observers and that which can be communicably observed; and to have order, not chaos, to communicate, there must be certain constraints in the internal structure of the observing systems.

1080

Illinois U. Electrical Engineering Research Lab., Urbana.

CONSTRAINT ANALYSIS OF MANY-DIMENSIONAL RELATIONS, by W. R. Ashby. May 1964, 16p. incl. diagrs. (Technical rept. no. 2) (AFOSR-64-1367) (AF AFOSR-63-7) AD 604042   Unclassified

As part of an attempt to apply information theory to the internal activities of large systems, a preliminary study was made of the simplifications possible when the data about the linkage between variables was merely whether the linkage was zero or non-zero. The study thus became a study of how to simplify an n-ary relation. The idea is here treated rigorously, and a method is developed for detecting and measuring the degree of essential simplicity. The individual relation is made to generate a sequence of progressively simpler relations; where it comes in the sequence determines and measures its degree of essential simplicity. The method may be useful when one wishes to consider relations (or systems) that, while involving very large numbers of variables, retain some simplicity derived from the sub-relations that formed them.

1081

Illinois U. [Electrical Engineering Research Lab.] Urbana.

COGNITRON THEORY, by R. J. Swallow. June 1964, 243p. incl. diagrs. tables. (AFOSR-65-0582) (AF AFOSR-63-7) AD 614006   Unclassified

The Cognitron is a net of artificial neurons, sensory neurons, and muscles whose properties were chosen with the intent that they conform to a diversified amount of physiological and psychological data. This paper rigorously analyzes the behavior of small nets of its artificial elements in order to indicate some of the similarity between their behavior and human mental behavior. Results indicate that the conditioned reflex-like activity of these small nets is reinforced to a degree dependent on a property of the nets closely resembling one's intuitive idea of the "newess" of the nets' input and internal pulse states. It is suggested that the newness is the rewarding property governing reinforcement in the animal mind and that this reinforcement property generalizes the rewarding and punishing effects of food and pain stimuli, respectively so as to include the rewarding effects of "new" environments. It is also suggested that chain conditioned relfex activity in the animal does not exceed a few steps because the response becomes "old", loses its rewarding effects, and thus prevents any further conditioned reflex activity which involves that particular response.

1082

Illinois U. [Electrical Engineering Research Lab.] Urbana.

ON STRUCTURAL ANALYSIS OF MANY VALUED LOGIC, by H. S. H. Na, H. von Foerster, and G. Gunther. Apr. 1964, 169p. (AFOSR-64-1381) (AF AFOSR-63-6) AD 604045   Unclassified

Traditional logic deals with systems of two binary variables, i.e., each variable being two valued. Boolean system deals with n binary variables. In this paper systems with n variables, each being m valued, are studied. Such systems are divided into three classes: balanced, whenever $n = m$; under-balanced, whenever $m < n$; and over-balanced whenever $m > n$. Some of the structural properties of these systems, e.g., reducibility and decomposability, as well as those of the components (i.e., individual functions), e.g., resolvability are considered. Relations among various (m, n)-systems are partially established.

1083

Illinois U. [Electrical Engineering Research Lab.] Urbana.

A NEW CLASS OF TUNABLE RC NULL NETWORKS, by D. A. Calahan. [1963] 20p. (AFOSR-J460) (AF AFOSR-63-177) AD 406998   Unclassified

Also published in Proc. Midwest Symposium, Wisconsin, May 1963.

The problem of synthesis of a variable-null, grounded lumped element RC network is considered. Necessary and sufficient conditions for realization are discussed, although complete realizability conditions are not derived. An approximation scheme is developed which allows a transmission zero to be varied along the imaginary axis while maintaining a reasonable null characteristic. Measurements on physical models are given.

1084

[Illinois U. Electrical Engineering Research Lab., Urbana]

MILLIMETER WAVE GENERATION BY MULTIPLE QUANTUM CONVERSION (Abstract), by D. P. Akitt and P. D. Coleman. [1964] [2]p. (AFOSR-65-0443) (AF AFOSR-63-272) AD 614092   Unclassified

Presented at Second annual Rev. of Electronics, Illinois U., Urbana, Nov. 17-18, 1964.

During this experiment 1 watt of power was produced at 105 Gc by a travelling wave multiple photon interaction in HCN gas, which possibly is the most power produced by a quantum electronics scheme in the low mm-λ portion of the spectrum. The $J = 0$, $J = 1$ levels of HCN provide a 2 level system with a natural frequency $\Omega 88.6$ Gc, with a pumping frequency $\omega = 35$ Gc $(\approx \Omega/3)$, and power being produced at odd harmonics of ω. The interaction region containing HCN consists of a moderate length of RG 96/μ rectangular waveguide. Field strengths of the order of 25 kv/cm, necessary to produce high harmonic power, are produced by a commercially available Sylvania magnetron. The fundamental power propagates in the TE_{10} mode and the harmonic is produced in the TE_{30} mode. A coupler at the end of the interaction region extracts the harmonic power.

1085

Illinois U. [Electrical Engineering Research Lab.] Urbana.

VACUUM-GRATING MONOCHROMATOR FOR THE 100μ - 2500μ REGION (Abstract), by R. Roldan. [1964] [1]p. (AFOSR-65-0449) (AF AFOSR-63-272)
                                              Unclassified

Presented at Second annual Rev. of Electronics, Illinois U., Urbana, Nov. 17-18, 1964.

A vacuum-grating monochromator is described covering the spectral region from $100-2500\mu$. The instrument has an f/2.3, on axis optical system in Littrow mount. Several echelette gratings are used to span the region of interest. Filter gratings used in 0th order, quartz plates, NaCl and black polyethylene remove the higher frequency radiation coming from a mercury arc used as a source. A Golay Cell is employed as the detector together with a synchronous rectifier and the signal is displayed in a conventional recorder. Preliminary spectra of H_2O in the region from 300-600 reveal 9 strong bands in agreement with the predictions of Benedict. These spectra show a resolution of 12μ at 500μ and required a scanning time of approx. 1 hr with an apparent S/N ratio of 10.

1086

Illinois U. [Electrical Engineering Research Lab.] Urbana.

INDUCTION, PREDICTION, AND DECISION-MAKING IN CYBERNETIC YSTEMS, by W. R. Ashby. [1963] [12]p. (AFOSR-64-2006) (AF AFOSR-64-7) AD 451576
                                              Unclassified

Also published in Induction: Some Current Issues, Middletown, Wesleyan U. Press, 1963, p. 55-66.

The concepts of induction and deduction, as they came to us from the Greeks, were associated with the assumption that they might give a truth that would hold universally without any limit or condition. This assumption, implying that the process ends with an infinite quantity of information, is rejected, for no human or mechanical system can process more than a finite quantity. When the processes of induction and deduction are re-examined in the forms in which they are actually used in human thought processes, they are found to follow the same basic methods, and to be subject to the same basic laws, as when they are used in machines.

1087

Illinois U. [Electrical Engineering Research Lab.] Urbana.

[THE PROBLEM OF FORMALIZATION OF THE TRANSCENDENTAL-DIELECTIC LOGIC, WITH SPECIAL REGARD TO THE LOGIC OF HEGEL] Das Problem einer Formalisierung der Transzendentai-Dialektischen Logik, by H. Heimsoeth, J. Derbolav and others. [1964] [59]p. incl. diagrs. refs. (AFOSR-65-0698) (AF AFOSR-64-480) AD 617860   Unclassified

Also published in Hegel-Studien, Suppl. 1: 65-123, 1964.

In this investigation, the problem of the formalization of transcendental-dialectic logic, which is the basis of German idealism, is considered. A direct investigation is made of the existing historical writings of authors Kant, Fichte, Hegel and Schelling in the language of a formal calculus. A new statement of the essential problem, which revealed itself in the development of the positive philosophy from Kant to Schellings on the basis of a transclassical formalism, is treated here. Questions such as what is transcendental appearance, subjectivity, introspection, and transference of thoughts are entirely independent, so that they represent the main problem of idealism, and are investigated through their formal logical structure.

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Indiana U. Dept. of Chemistry, Bloomington.

DISTRIBUTION AND RELAXATION OF VIBRATIONALLY

EXCITED OXYGEN IN FLASH PHOTOLYSIS OF
OZONE, by R. V. Fitzsimmons and E. J. Bair. [1964]
[6]p. incl. diagrs. table, refs. (AFOSR-66-0593)
(AF 49(636)1257) AD 632176   Unclassified

Also published in Jour. Chem. Phys., v. 40: 451-458,
Jan. 1964.

Absolute absorption by a sequence of bands in the
Schumann-Runge series arising from oxygen mole-
cules in vibrationally excited levels of the ground state
formed by secondary processes of the flash photolysis
of ozone was measured as a function of time. Meas-
urements of bands arising from states $v'' = 13$ through
$v'' = 19$ are analyzed in terms of a continuously gen-
erated initial distribution which relaxes to room tem-
perature in single quantum steps. The vibrational
relaxation rate constants are large and are interpreted
as an efficient transfer of vibrational energy between
ozone and excited oxygen. The relaxation process is
consistent with a single quantum step model, and if
deviations from this model are real, they are secondary.
Vibrationally excited oxygen is formed initially in all
of the observed states. (Contractor's abstract, in
part)

1089

Indiana U. Dept. of Chemistry, Bloomington.

SPECTROMETRIC STUDIES OF FAST REACTIONS,
by E. J. Bair. Final rept. Oct. 1, 1963 [17]p. incl.
diagrs. tables, refs. (AFOSR-J1616) (AF AFOSR-
62-36) AD 427636   Unclassified

Reprints of the following 2 papers published during the
investigation are included in this report: (1) Reactions
of nitrogen-hydrogen radicals. I. NH_2 recombination
in the decomposition of ammonia, and (2) Distribution
and relaxation of vibrationally excited oxygen in flash
photolysis of ozone.

1090

Indiana U. [Dept. of Chemistry] Bloomington.

A CONFIGURATION INTERACTION STUDY OF THE
GROUND STATE OF THE H_3^+ MOLECULE, by R. E.
Christoffersen. Dec. 1963, 1v. incl. diagrs. tables,
refs. (AFOSR-64-0001) (AF AFOSR-62-163)
AD 430893   Unclassified

A configuration interaction calculation on the ground
state of H_3^+ has been done using Slater-type orbitals
of the form 1s, 2s, $2p_x$, $2p_y$, $2p_z$ to form the basis
set. The calculation was effected by approximating the
exact wave function for the system by a linear combi-
nation of configurations, each of which is a properly
antisymmetrized function constructed from the basis
orbitals, and by applying the variation theorem to the
approximate wave function. The most stable geometry
for H_3^+ is an equilateral triangle. The best energy ob-
tained for the equilateral triangle was -1.33264

Hartrees at R = 1.6575 Bohrs. The fundamental vibra-
tional frequencies for the ground state have also been
calculated.

1091

Indiana U. Dept. of Chemistry, Bloomington.

DIAMAGNETIC NUCLEAR SHIELDING CONSTANTS
FOR NEUTRAL ATOMS, by R. A. Bonham and T. G.
Strand. [1964] [2]p. incl. table. (AFOSR-64-1495)
(AF AFOSR-62-322) AD 446140   Unclassified

Also published in Jour. Chem. Phys., v. 40: 3447-
3448, June 1, 1964.

The purpose of this note is to present the results for
the diamagnetic shielding constants for the neutral
atoms from Z = 2 to Z = 100 using a Hartree-Fock elec-
tron density function for the atoms Z = 2 to Z = 36, and
a Thomas-Fermi-Dirac (TFD) electron density function
for the atoms from 2 to 100.

1092

Indiana U. Dept. of Chemistry, Bloomington.

THE THEORY OF ELECTRON SCATTERING FROM
MOLECULES. II. MOLECULAR HYDROGEN, by R. A.
Bonham and T. Iijima. [1963] [7]p. incl. diagrs. tables,
refs. (AFOSR-64-1497) (AF AFOSR-62-322)
AD 446125   Unclassified

Also published in Jour. Phys. Chem., v. 67: 2266-
2272, Nov. 1963.

Expressions for the differential cross sections for the
total electron scattering (including all inelastic proc-
esses) and the elastic electron scattering from molecu-
lar hydrogen have been derived. The total molecular
intensity has been computed with both the Wang and
Weinbaum molecular wave functions and the effect of
the chemical bond on these calculations is discussed.
The binding effects should contribute only small cor-
rections to the usual interpretation of diffraction re-
sults for the case of H_2 unless extremely small angle
scattering data were available.

1093

Indiana U. Dept. of Chemistry, Bloomington.

MODIFICATION TO THE NEWTON-RAPHSON METHOD
FOR THE FITTING OF NONLINEAR FUNCTIONS BY
LEAST SQUARES, by T. G. Strand, D. A. Kohl, and
R. A. Bonham. [1963] [4]p. incl. tables. (AFOSR-
64-1496) (AF AFOSR-62-322) AD 446356
          Unclassified

Also published in Jour. Chem. Phys., v. 39: 1307-
1310, Sept. 1, 1963.

A modification to the regularly used methods for the
fitting of nonlinear functions by least squares is

presented. The modified method converges in fewer cycles of the iterative solution than the unmodified Newton-Raphson method, and in certain cases, the modification makes the iteration converge from starting vectors for which the unmodified method diverges. A numerical example is given, where the modification is used with the Newton-Raphson method to obtain an analytical expression for the Thomas-Fermi-Dirac potential function of an atom. The solutions from the modified method are discussed in relation to the results of the unmodified ones for different starting values of the parameters.

1094

Indiana U. Dept. of Chemistry, Bloomington.

ANALYTICAL EXPRESSIONS FOR POTENTIALS OF NEUTRAL THOMAS-FERMI-DIRAC ATOMS AND THE CORRESPONDING ATOMIC SCATTERING FACTORS FOR X RAYS AND ELECTRONS, by R. A. Bonham and T. G. Strand. [1963] [5]p. incl. diagrs. tables, refs. (AFOSR-64-1499) (AF AFOSR-62-322) AD 446362
Unclassified

Also published in Jour. Chem. Phys., v. 39: 2200-2204, Nov. 1, 1963

Approximate analytical expressions for the electrostatic potentials of neutral Thomas-Fermi-Dirac atoms have been obtained by fitting a sum of three exponential terms to the tabulated values by least-squares methods. The six different parameters used for each atom are expressed as functions of the atomic number. The corresponding expressions for the radial electron density, the mean-square radius, the diamagnetic susceptibility, the atomic scattering factors for x rays and the atomic scattering factors for electrons according to the first Born approximation are given. The accuracy of the approximate expressions are discussed in relation to results obtained from the tabulated values of the electrostatic potential and from the corresponding electron density.

1095

Indiana U. [Dept. of Chemistry] Bloomington.

X-RAY SCATTERING FACTOR OF A HYDROGEN ATOM IN A HYDROGEN MOLECULE, by T. Iijima and R. A. Bonham. [1963] [2]p. (AFOSR-64-1500) (AF AFOSR-62-322) AD 446363
Unclassified

Also published in Acta Cryst., v. 16: 1061-1062, Oct. 1963.

The effective scattering factor of a hydrogen atom in a hydrogen molecule was calculated and the magnitude was found to be generally less than that for an isolated hydrogen atom. This fact was interpreted as due to migration of electrons away from the nucleus into the bond. The x-rays and electrons in the wave length region usually used in structural analysis work are mainly sensitive to the contraction of the overall size of the electron cloud of the hydrogen atoms in molecular hydrogen as compared with their size in the free state.

The enhancement of the electron density in the neighborhood of the bond or the nucleus is accomplished by a decrease of density on the side of the nucleus away from the bond. The latter effect is the most significant one in the calculation of the corrections to the x-ray scattering factor for atomic hydrogen in molecular hydrogen.

1096

Indiana U. Dept. of Chemistry, Bloomington.

THE NATURE OF THE TWO-ELECTRON CHEMICAL BOND. III. NATURAL ORBITALS FOR H_2, by S. Hagstrom and H. Shull. [1963] [6]p. incl. tables, refs. (AFOSR-64-1520) (AF AFOSR-63-362) AD 445930
Unclassified

Also published in Rev. Modern Phys., v. 35: 624-629, July 1963.

It has seemed desirable to explore the natural orbital representation of H-molecule wave functions in detail with an accurate H_2 wave function. The results of this study are presented in this paper using the wave function obtained by Hagstrom. This function represents an expansion in terms of configurations of products over basis orbitals. The latter were chosen in elliptical coordinates. It can be said that the present calculations confirmed in detail previous surmises about (1) the invariance of the natural orbital expansion, (2) its utility in wave-function comparison, (3) the similarities between He and H_2, (4) the rough additivity of correlation energies of different types.

1097

Indiana U. Dept. of Chemistry, Bloomington.

THE NATURE OF THE TWO-ELECTRON CHEMICAL BOND. VI. NATURAL ORBITAL ANALYSIS FOR HeH^+, by B. G. Anex and H. Shull. [1964] [13]p. (AFOSR-64-1522) (AF AFOSR-63-362) AD 446371
Unclassified

Also published in Molecular Orbitals in Chemistry, Physics, and Biology, New York, Academic Press, 1964, p. 227-239.

This paper presents a contribution to the understanding of the detailed course of events that occurs in passing from the separated atoms of He + H^+ through the heteropolar hydride, HeH^+, to the united atom of Li^+. The molecule ion HeH^+ represents the simplest heteropolar two-electron chemical bond.

1098

Indiana U. Dept. of Chemistry, Bloomington.

ELECTRON DIFFRACTION DETERMINATION OF THE MOLECULAR STRUCTURE OF THE BUTYL HALIDES. V. THE STRUCTURE AND CONFORMATIONAL

ANALYSIS OF ISOBUTYL CHLORIDE, by G. H. Pauli, F. A. Momany, and R. A. Bonham. [1964] [3]p. incl. diagrs. tables, refs. (AFOSR-64-1537) (AF AFOSR-64-602) AD 446127   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 1286-1288, Apr. 5, 1964.

The structure and conformational analysis of gaseous isobutyl chloride has been carried out by the sector-microphotometer method of electron diffraction. The molecular parameters for the bonded distances were calculated. About 80% of the molecules at room temperature were in the conformer where the chlorine is gauche to one methyl group and trans to the other. The gauche angle for this conformer was found to be 66 degrees. A summary of the data on the available structural parameters for butyl halide molecules is given.

1099

Indiana U. Dept. of Chemistry, Bloomington.

ANALYTICAL EXPRESSIONS FOR THE HARTREE-FOCK POTENTIAL OF NEUTRAL ATOMS AND FOR THE CORRESPONDING SCATTERING FACTORS FOR X RAYS AND ELECTRONS, by T. G. Strand and R. A. Bonham. [1964] [6]p. incl. diagrs. tables. (AFOSR-64-1538) (AF AFOSR-64-602) AD 446132
Unclassified

Also published in Jour. Chem. Phys., v. 40: 1686-1691, Mar. 15, 1964.

Approximate analytical expressions for the Hartree-Fock potential of neutral atoms to $Z = 36$ have been obtained by fitting the radial electron density with an analytical expression by least squares. The accuracy of the approximate expressions is discussed in relation to results obtained by numerical calculations from the Hartree-Fock wavefunctions for the atoms.

1100

Indiana U. [Dept. of Chemistry] Bloomington.

ON THE CALCULATION OF MULTICENTER TWO ELECTRON REPULSION INTEGRALS INVOLVING SLATER FUNCTIONS, by R. A. Bonham, J. L. Peacher, and H. L. Cox, Jr. [1964] [4]p. (AFOSR-64-1539) (AF AFOSR-64-602) (AF AFOSR-64-602) AD 446133   Unclassified

Also published in Jour. Chem. Phys., v. 40: 3083-3086, May 15, 1964.

Integral transforms are used to evaluate many-center two-electron repulsion integrals involving Slater s-type functions. The reduction of a general four-center integral of this type to a form convenient for computational purposes is presented. The technique described has the important advantage that all lesser many-center and one-center integrals can be obtained from the four-center case by proper choice of constants. The form of the result is such that simple single-precision

numerical techniques yield rapid and accurate evaluations of many-center integrals. Several numerical examples are presented.

1101

Indiana U. Dept. of Chemistry, Bloomington.

CALCULATION OF ELECTRON SCATTERING FACTORS. I. NONRELATIVISTIC THEORY, by J. Karle and R. A. Bonham. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1540) (AF AFOSR-64-602) AD 446131   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1396-1401, Mar. 1, 1964.

Scattering factors for the elastic scattering from uranium and argon of 40-kv electrons have been obtained by partial wave analysis. In the case of argon both Thomas-Fermi-Dirac and Hartree-Fock fields were used in the calculation. For uranium, only the Thomas-Fermi-Dirac field was utilized. Various approximate techniques for obtaining the partial waves as well as direct numerical integration of the Schrodinger equation were employed. For the first time accurate numerical solutions of the electron scattering problem in the kv energy range, within the framework of the usual non-relativistic scattering theory, have been obtained.

1102

Indiana U. Dept. of Chemistry, Bloomington.

ON PLANETARY ELECTRON CORRECTIONS TO ELECTRON DIFFRACTION INTENSITY DATA, by T. Iijima and R. A. Bonham. [1964] [4]p. incl. diagrs. (AFOSR-65-0013) (AF AFOSR-64-602) AD 455823
Unclassified

Also published in Jour. Phys. Chem., v. 68: 3146-3149, Nov. 1964.

A new technique for correcting electron diffraction intensity data for planetary electron scattering from molecules in the gas phase is presented. The procedure does not make any assumptions about the molecular structure but still guarantees that the radial distribution will remain positive. Corrections to the peak areas in the resulting radial distribution function are discussed and the possible application of the technique to the analysis of x-ray scattering data from liquids is pointed out. (Contractor's abstract)

1103

Innsbruck U. Inst. for Theoretical Physics (Austria).

THE CROCCO THEOREM IN MAGNETOGASDYNAMICS, by F. Cap. Apr. 9, 1963, 5p. (Technical note no. 1) (AFOSR-5247) (AF 61(052)675) AD 416532
Unclassified

Crocco's theorem establishing a connection between entropy gradients and vorticity is derived for a plasma

(MHD theory). The theorem was applied to a plasma of infinite conductivity and the conditions permitting potential flow, i.e. vanishing vorticity, are discussed.

1104

Innsbruck U. Inst. for Theoretical Physics (Austria).

POTENTIAL FLOW IN MAGNETO GAS DYNAMICS, by F. Cap. Apr. 9, 1963, 6p. (Technical note no. 2) (AFOSR-5248) (AF 61(052)675) AD 416360
Unclassified

Also published in Ann. Physik, v. 7: 197-200, 1963. (AFOSR-64-0304; AD 440597)

The differential equation of compressible potential flow and the St. Venant-Wantzel equation were derived for a plasma with infinite conductivity. Gasdynamic methods are applied to solve the potential equation and Bernouille's equation. The efflux formula is discussed. (Contractor's abstract)

1105

Innsbruck U. Inst. for Theoretical Physics (Austria).

APPLICATION OF VARIATIONAL METHODS FOR THE SOLUTION OF GASDYNAMIC AND MAGNETO-GASDYNAMIC PROBLEMS, by F. Cap and G. Muller. Feb. 25, 1964, 7p. (Scientific rept. no. 8) (AFOSR-65-0927) (AF 61(052)675) AD 614051   Unclassified

Because a change from subsonics to supersonics involves a change in the type of potential equation of gasdynamics and magnetogasdynamics, a uniform solution is impossible. In the variational principle presented in this paper, this difficulty does not arise. The variational method given allows numerical calculation of the magnetogasdynamic subsonic to supersonic transition of 2-dimensional steady potential flows of a plasma.

1106

Innsbruck U. Inst. for Theoretical Physics (Austria).

INTERPRETATION OF MAGNETOGASDYNAMIC FLOW PATTERNS, by F. Cap and H. Friedel. Apr. 25, 1964, 17p. incl. diagrs. tables. (Scientific rept. no. 10) (AFOSR-65-0928) (AF 61(052)375) AD 814050
Unclassified

For initial magnetic fields of 0, 1000, 5000 and 10,000 gauss the 2-dimensional steady flow of a plasma in a nozzle is constructed using the magnetogasdynamic characteristics method of F. Cap. (Contractor's abstract)

1107

Innsbruck U. Inst. for Theoretical Physics (Austria).

SOME PRACTICAL EXAMPLES OF ONE-DIMEN-

SIONAL UNSTEALY POTENTIAL FLOWS IN MGD, by F. Cap and F. Herrnegger. June 14, 1964, 18p. incl. diagrs. tables. (Scientific rept. no. 11) (AFOSR-65-0929) (AF 61(052)675) AD 614052   Unclassified

For initial magnetic fields of 5000 and 50,000 gauss, the 1-dimensional unsteady flow of a plasma in a tube is constructed using the magnetogasdynamic characteristics method of F. Cap. (Contractor's abstract)

1108

Innsbruck U. Inst. for Theoretical Physics (Austria).

MAGNETOGASDYNAMIC WAVES OF SMALL AMPLITUDE, by F. Cap and H. Friedel. July 14, 1964, 13p. incl. diagrs. (Scientific rept. no. 12) (AFOSR-65-0930) (AF 61(052)675) AD 613621   Unclassified

In this note the propagation of magnetogasdynamic waves with small amplitude is studied by two methods. In the first, calculations are based on linearized equations, the propagation of plane waves being studied in a medium at rest. In the second, perturbations of a more general type are examined and the theory of characteristics applied. Both methods yield consistent results proving the existence of fast and slow magnetoacoustic waves.

1109

Innsbruck U. Inst. for Theoretical Physics (Austria).

SHOCK WAVES, by F. Cap and F. Herrnegger. Sept. 9, 1934, 14p. incl. diagrs. (Scientific rept. no. 13) (AFOSR-85-0931) (AF 61(052)675) AD 814053
Unclassified

The basic equations for stationary magnetohydrodynamic shock waves are given as well as the laws of conservation following from them and the shock equations. The evolutionary conditions for fast and slow shock waves are discussed by the shock polar diagram. Waves, both parallel and oblique to the magnetic field, are considered.

1110

Innsbruck U. Inst. for Theoretical Physics (Austria).

VORTEX THEOREMS AND POTENTIAL FLOW IN MGD, by F. Cap and H. Friedel. Sept. 25, 1964, 9p. incl. diagr. (Scientific rept. no. 14) (AFOSR-65-0932) (AF 81(052)875) AD 613823   Unclassified

Necessary conditions for the existence of a velocity potential in magnetogasdynamics (MGD) are derived on the basis of general MGD vortex theorems. Two types of MGD flows fulfilling these conditions are given: 1-dimensional and 2-dimensional flows with transversal magnetic fields. Finally, the existence of a potential equation for the special case of a longitudinal magnetic field is shown. (Contractor's abstract)

1111

Innsbruck U. Inst. for Theoretical Physics (Austria).

INTERACTION BETWEEN MAGNETIC FIELD AND
FLOW FIELD FOR PLASMAS OF INFINITE CONDUC-
TIVITY, by F. Cap and G. Kerer. Oct. 15, 1964, 6p.
incl. diagrs. (Scientific rept. no. 17) (AFOSR-65-
0933) (AF 61(052)675) AD 617553   Unclassified

Assuming that the boundary curve of a 2-dimensional
steady flow is given analytically and that the magnetic
field in the whole flow domain is vertical to the flow
velocity, the magnetic field at the domain is calculated.
The magnetic field at the boundary is also calculated
for a flow coming from an idealized nozzle and for the
circulation flow, and from these results the differential
equation for the former field is simplified. Finally it is
proved that for a 2-dimensional steady flow $\vec{V} = (v_x, v_y,$
0) and $\vec{H} = (0, 0, H_z)$, the 2 equations curl $[\vec{v} \times \vec{H}] = 0$
and $\vec{H} = $ constant ρ are identical.

1112

Innsbruck Inst. for Theoretical Physics (Austria).

VARIATIONAL METHODS FOR THE SOLUTION OF
TWO-DIMENSIONAL STEADY MAGNETOGASDYNAM-
IC FLOWS, by F. Cap and G. Mueller. Sept. 23, 1964,
12p. (Scientific rept. no. 19) (AFOSR-65-0934)
(AF 61(052)675) AD 613624   Unclassified

In a former paper, a variational problem was presented
for 2-dimensional steady magnetogasdynamic potential
flow. This note continues the investigation and intro-
duces a variational problem using polar coordinates,
which is solved by the Ritz method. The boundary con-
dition given is that the radial component of the velocity
has to vanish on the cylinder surface. A solution is
presented by expansion into a series.

1113

Innsbruck U. Inst. for Theoretical Physics (Austria).

GASDYNAMIC METHODS IN MHD FLOW, by F. Cap,
G. Kerer and others. Final rept. Jan. 1, 1963-Dec.
31, 1964, 41p. incl. refs. (Summary rept. no. 1)
(AFOSR-65-1045) (AF 61(052)675) AD 619094
Unclassified

During this investigation, the following was accomp-
lished: (1) It was proven that potential flow can exist
in a plasma under certain conditions; (2) A theorem
was derived connecting vorticity, the geometrical
form of the magnetic field, Ohmic heating and entropy
gradients; (3) A perturbational approach was developed
for deriving solutions for a plasma with finite electri-
cal conductivity from solutions for a plasma with infi-
nite electrical conductivity; (4) A method for the solu-
tion of 2-dimensional steady potential flow of a plas-
ma, using characteristics in the hodograph plane, was
found; and (5) A variational method was discovered by

which the transition from subsonic, i.e., $a^2 + v^2 < v^2$,
to supersonic, i.e., $a^2 + v^2 > v^2$, through transonic,
i.e., $a^2 + v^2 \approx v^2$, can be calculated numerically.

1114

Innsbruck U. Inst. for Theoretical Physics (Austria).

NUMERICAL METHODS IN GASDYNAMICS AND MGD
by F. Cap and F. Herrnegger. Dec. 21, 1964 [17]p.
incl. diagrs. refs. (Scientific rept. no. 18) (AFOSR-
65-1805) (AF 61(052)675) AD 622093   Unclassified

Methods for estimating solutions of differential equations
in gasdynamics are presented relevant to their applica-
tions to magnetohydrodynamics. The differential equa-
tions considered are confined to those of second order
with two variables, that is, to unsteady 1-dimensional
and steady 2-dimensional problems. General principles
of error compensation are considered. Methods of es-
timation include methods of variations, difference
methods, methods of characteristics, and methods of
transformations.

1115

Innsbruck U. Inst. for Theoretical Physics (Austria).

THE PRESSURE HILL AND THE ADIABATIC ELLIPSE
IN MAGNETOGASDYNAMICS, by F. Cap and R.
Skarics. July 25, 1963 [9]p. incl. tables. (Technical
note no. 3) (AFOSR-65-2312) (AF 61(052)675)
AD 429506   Unclassified

On the basis of Bernoulli's equations for a potential
flow in magneto-gasdynamics, a modified Saint-Venant
Wantzel formula of efflux is derived. Pressure as a
function of the velocity of efflux is calculated for mag-
netic field strengths of 0, 5,000, and 10,000 gauss.
The equation of a modified adiabatic ellipse is deduced
with the aid of an auxiliary quantity for calculation,
closely basing on gas dynamics. Furthermore, expres-
sions interrelating the flow velocity, the modified Mach
number, and the modified critical Mach number are
studied. (Contractor's abstract)

1116

Innsbruck U. [Inst. for Theoretical Physics] (Austria).

APPROXIMATIVE SOLUTION OF THE MAGNETOHY-
DRODYNAMIC EQUATIONS FOR FINITE CONDUCTIV-
ITY, by F. Cap and G. Kerer. July 25, 1963, 3p.
(Technical note no. 4) (AF 61(052)675) AD 428977
Unclassified

Proceeding from the basic equations for steady two-
dimensional potential flow, the basic magnetogasdynam-
ical equations are linearized by means of perturbation
calculations disregarding gravity, friction and thermal
conduction.

1117

Institut d'Optique, Paris (France).

SIMULTANEOUS DETERMINATION OF SCATTERING
PARAMETER AND MEAN FREE PATH OF CONDUC-
TION ELECTRONS IN THIN FILMS, by M. -L. Theye.
[1964] [4]p. incl. diagrs. (AFOSR-64-1778) (
(AF EOAR-63-48) AD 449197   Unclassified

Also published in Jour. Phys., v. 25: 194-197, Jan. -
Feb. 1964.

Combined study of the optical properties and of the
electrical resistivity of a thin film of known thickness,
enables simultaneous unequivocal determination of both
the mean free path l of the conduction electrons, and
the fraction p of them which is specularly reflected on
the two planes limiting the film. The method described,
applied to thin Au films, shows that the scattering pa-
rameter p may be different from zero for thin films
prepared by vacuum evaporation on amorphous sub-
strates and annealed at suitable temperatures.

1118

Institut d'Optique, Paris (France).

METER AMPLIFIER FOR CONDUCTIVITY MEASURE-
MENTS IN LOW-CONDUCTIVITY LIQUIDS, by I.
Wilmanns. [1964] [2]p. (AFOSR-64-2120) (AF EOAR-
63-48) AD 451579   Unclassified

Also published in Jour. Scient. Instruments, v. 41:
400, June 1964.

A simple measurement circuit is described which per-
mits simultaneously the surveyance of the washing ac-
tion of demineralized water and of the reclaiming action
of the deionization column.

1119

Institut d'Optique, Paris (France).

OPTICAL PROPERTIES OF INHOMOGENEOUS
FILMS, by F. Abeles. [1964] [18]p. incl. diagrs.
tables. (AFOSR-65-0157) (AF EOAR-63-48)
AD 611494   Unclassified

Also published in Proc. Symposium on Ellipsometry in
the Measurement of Surfaces and Thin Films,
Washington, D. C. (Sept. 5-6, 1963), p. 41-58.

The inhomogeneous films investigated have a refractive
index n which is a function of the single coordinate z,
the axis Oz having the direction of the normal to the
planes which limit the layer. The discussion is limit-
ed to non-absorbing films, although mention is made of
the possibilities of using the same methods for absorb-
ing layers. Three different methods of computation are
described: (1) use of the differential wave equation; (2)
WKB approximation; and (3) replacement of an inho-
mogeneous layer by a pile of homogeneous films.

1120

Institut d'Optique, Paris (France).

[A NEW SYNCHRONOUS RECTIFIER] Un nouveau re-
dresseur synchrone, by I. Wilmanns. [1964] [2]p. incl.
diagrs. (AFOSR-65-0745) (AF EOAR-63-48)
AD 615071   Unclassified

Also published in Jour. Phys. (Paris), v. 25: 173A-
174A, Nov. 1964.

Circuits using synchronous rectifiers are in general
very complicated. This paper describes a circuit, con-
sisting of two transistors (n-p-n and p-n-p) with single
ended reference input and no drift. It is easy to obtain
time constants of several seconds.

1121

[Institut National d'Hygiene]. Marseille (France).

THE VISUALLY EVOKED POTENTIALS RECORDED
TRANSCRANIALLY IN NORMAL MAN, by H. J. P.
Gastaut. Final rept. Oct. 31, 1964 [30]p. incl. illus.
diagrs. refs. (AFOSR-65-1686) (AF EOAR-64-15)
AD 624103   Unclassified

A study was made of the relationships between the EEG
and the behavior or sensory-motor functions of normal
man. An evaluation was made of the utility of the
Phasotron. An investigation was made of the different
aspects of the visually-evoked potentials recorded
transcranially in healthy and diseased man.

1122

Institute for Advanced Study, Princeton, N. J.

PROPERTIES OF CERTAIN TYPES OF WILD SUR-
FACES IN E^3, by C. E. Burgess. [1964] [14]p. incl.
refs. (AFOSR-65-1398) (AF 49(638)253) AD 621401
          Unclassified

Also published in Amer. Jour. Math., v. 86: 325-338,
Apr. 1964.

Let S be a wild 2-sphere in E^3 such that S + IntS is a
topological cube, and let W be the set of all wild points
on S. It is shown that if S_1 is a 2-sphere in S + IntS
such that $W \subset S_1$, then S_1 is wild at each point of W.
Also if W is a subset of a tame Cantor set in E^3, then
there is a tame 2-sphere S_2 such that $S \cdot S_2 = W$ and
$S_2 \subset S + ExtS$. The results for 2-spheres are used to
obtain similar theorems for connected 2-manifolds in a
3-manifold.

1123

Institute for Advanced Study, Princeton, N. J.

HARMONIC EXTENSIONS, by M. Morse. [1963] [9]p.
(AFOSR-4925) (AF AFOSR-62-227) AD 453836
Unclassified

Also published in Monatsh. Math., v. 67: 317-325,
1963.

In this paper the analytic case of the theory of
Schoenflies extension problems or more precisely with
a classical theorem on harmonic extension is studied.

1124

Institute for Advanced Study, Princeton, N. J.

ON THE BORN APPROXIMATION IN THE POTENTIAL
SCATTERING OF PARTICLES WITH ARBITRARY
SPINS, by F. Calogero and J. M. Charap. [1964] [17]p.
(AFOSR-64-0552) (AF AFOSR-63-42)   Unclassified

Also published in Ann. Phys., v. 26: 55-71, Jan. 1964.

The Born approximation to the scattering amplitude is
discussed for the potential scattering problem with many
channels and arbitrary spins. This is done for the full
amplitude in both the representation in which magnetic
quantum numbers are diagonal and in the helicity repre-
sentation, and for the partial wave amplitude in the he-
licity representation. Spin-orbit interactions are also
treated. A discussion of the asymptotic behavior for
large momentum transfer is given, on the basis of which
it is conjectured that for a specified class of potentials
the Regge poles will retreat to the left-hand J-plane for
high energies. (Contractor's abstract)

1125

Institute for Advanced Study, Princeton, N. J.

THE CONTINUATION IN TOTAL ANGULAR MOMEN-
TUM OF PARTIAL-WAVE SCATTERING AMPLITUDES
FOR PARTICLES WITH SPIN, by J. M. Charap and
E. J. Squires. [1963] [15]p. (AFOSR-64-0798)
(AF AFOSR-63-42) AD 436478   Unclassified

Also published in Ann. Phys., v. 25: 325-339, Dec.
1963.

An assumed one-dimensional dispersion relation is used
to define a continuation in total angular momentum of
the helicity scattering amplitude, for particles with
arbitrary spin. The result, which is a generalization
of the Froissart-Gribov formula for zero spin, agrees
with that discussed previously for potential models. It
is shown that cross-channel unitarity imposed certain
restrictions on the weight functions. The existence
of certain kinematic zeros of the amplitude, correspond-
ing to the decoupling of sense and nonsense channels,
is proved in general, and finally it is shown that the
presence of the nonsense-nonsense amplitude does not
affect the large z behavior, which is still dominated by
Regge poles.

1126

Institute for Advanced Study, Princeton, N. J.

ASYMPTOTIC BEHAVIOUR FOR LARGE IMAGINARY
VALUES OF ANGULAR MOMENTUM OF THE AMPLI-
TUDES FOR THE SCATTERING OF A DIRAC PARTI-
CLE ON A CENTRAL SCALAR POTENTIAL, by F.
Calogero and J. M. Charap. [1964] [0]p. incl. diagr.
refs. (AFOSR-65-0478) (AF AFOSR-63-42)
AD 614206   Unclassified

Also published in Nuovo Cimento, Series X, v. 32:
1665-1684, June 16, 1964.

It is proved that the analytically continued partial-
wave amplitudes for the scattering of a Dirac particle
on a central scalar potential which may be expressed
as a superposition of Yukawa functions vanishes as
$|ImJ| \to \infty$. The potential has to be further res_icted
so that it vanishes at small distances and is weak.
The method of proof is based on the phase approach to
scattering theory. (Contractor's abstract)

1127

Institute for Advanced Study, Princeton, N. J.

ON MASSIVE AND MASSLESS PHOTONS, by N.
Dombrey. [1964] [11]p. (AFOSR-65-0479) (AF AFOSR-
63-42) AD 614184   Unclassified

Also published in Nuovo Cimento, Series X, v. 32:
1696-1706, June 16, 1964.

The vanishing of the longitudinal mode of massive
photon as the photon mass goes to zero in gauge-in-
variant electrodynamics is investigated. A distinction
between 2 forms of gauge-invariant amplitudes is made
in order to clarify this limit; conditions are then ob-
tained so that the limiting process is smooth. From
these conditions results on the equality of particle
charge which are usually derived by means of Ward's
identity can be obtained.

1128

Institute for Advanced Study, Princeton, N. J.

THE ELIMINATION OF CRITICAL POINTS OF A NON-
DEGENERATE FUNCTION ON A DIFFERENTIABLE
MANIFOLD, by M. Morse. [1964] [60]p. incl. refs.
(AFOSR-65-1040) (AF AFOSR-63-357) AD 617854
Unclassified

Also published in Jour. Anal. Math., v. 13: 257-316,
1964.

M is a compact, connected, orientable differentiable
n-manifold of class C^∞, and f is a non-degenerate func-
tion of class C^∞. This note reveals certain fundamen-
tal topological characteristics of M by combining the
study of the critical points of f with the study of certain
differentiable submanifolds of M associated with the

respective critical points of f and termed bowls of f. An attempt is made to modify f so as to eliminate as many critical points as possible, replacing f by another non-degenerate function. This is accomplished mainly through the development of a theorem concerning bowls and the existence of a non-degenerate function without critical points in a given neighborhood.

1129

Institute for Advanced Study, Princeton, N. J.

CONDITIONED DIFFERENTIABLE ISOTOPIES, by W. Huebsch and M. Morse. [1964] 25p. (AFOSR-65-1041) (AF AFOSR-63-357) AD 618619
Unclassified

Also published in Proc. Internat'l. Colloq. on Differential Anal., Bombay (India), 1964, p. 1-25.

In proving some of the recent theorems in differential topology, deeper reduction theorems and differentiable isotopies are required than those which have been presented. This note establishes one such theorem, concerning O-related diffeomorphisms. A Euclidean n-space with rectangular coordinates is used, and two special types of diffeomorphisms; ξ-diffeomorphisms and perispherical diffeomorphisms, are introduced and developed in proving the theorem.

1130

Institute for Advanced Study, Princeton, N. J.

REMARKS ON THE POLYNOMIAL BOUNDEDNESS IN THE MANDELSTAM REPRESENTATION, by Y. S. Jin and A. Martin. [1964] [7]p. incl. diagr. refs. (AFOSR-66-0449) (AF AFOSR-64-42) AD 630447
Unclassified

Also published in Jour. Math. Phys., v. 5: 1406-1412, Oct. 1964.

The Mandelstam representation is a statement about the region of analyticity and asymptotic behavior (polynomial boundedness) of a scattering amplitude. In virtue of the unitarity condition, however, these two are not completely independent. Some physical consequences, e.g., uniqueness, polynomial boundedness of the total cross section, etc., which have been already derived from the Mandelstam representation, are shown to be preserved, even if the polynomial boundedness is replaced by a somewhat weaker assumption. By making use of unitarity, analyticity, and crossing symmetry, the following type of scattering amplitude $F = E + M$, where E is an entire function in both variables s and t, while M denotes a Mandelstam-type function with finite number of subtraction, is shown to be ruled out. Similarly, $F = EM$ is also ruled out, if one imposes the additional restriction that E should increase less fast than an exponential in one variable while the other is finite. (Contractor's abstract)

1131

Institute for Advanced Study, Princeton, N. J.

REGGE-KHURI REPRESENTATION FOR PHOTOPRODUCTION, by Y. S. Jin and H. A. Rashid. [1964] [14]p. (AFOSR-66-0453) (AF AFOSR-64-42) Unclassified

Also published in Nucl. Phys., v. 58: 611-624, 1964.

The Gribov-Froissart continuations of various multipole amplitudes of the photo-pion production process into the complex J-plane are introduced. Assuming the meromorphy of these interpolated multipole amplitudes in the complex J-plane, the Regge-Khuri representation for the photo-pion production is obtained. The contribution of the nucleon Regge pole to the low-energy M_{1-} amplitude is briefly discussed. (Contractor's abstract)

1132

Institute for Advanced Study, Princeton, N. J.

SHELL MODEL OF BARYONS, by P. G. O. Freund and B. W. Lee. [1964] [4]p. incl. tables. (AFOSR-66-0454) (AF AFOSR-64-42) AD 630367 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 592-595, Nov. 16, 1964.

Consideration is given to some implications of the hypotheses that (1) baryons are built up on spin-1/2 fermions belonging to a unitary triplet (which are termed baryonettes); (2) within a baryon, these baryonettes move in a self-consistent central field, exhibiting a shell structure; (3) coupled spin-unitary-spin symmetry is not an intrinsic symmetry of the 'fundamental' Lagrangian, but a symmetry of the baryon wave function (in terms of baryonette coordinates) in the central-field approximation. This symmetry is broken by the residual interaction between baryonetts which is not accounted for by the central field. The basic triplet is assumed to have the charge structure (2/3, -1/3, -1/3), just as quarks, but for the present the baryon number b of baryonettes is left unspecified. Both LS -and jj-coupling shell models of baryons are discussed.

1133

Institute for Advanced Study, Princeton, N. J.

INTRINSICALLY BROKEN U(6) $\otimes$ U(6) SYMMETRY FOR STRONG INTERACTIONS, by K. Bardakci, J. M. Cornwall and others. [1964] [4]p. incl. table. (AFOSR-66-0474) (AF AFOSR-64-42) AD 630509
Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 698-701, Dec. 7, 1964.

The results of investigations that lead to the symmetry group SU(6) are extended to relativistic quantum field theory. A chain of symmetries is produced which culminates in the relationship $W_6 = U(6) \otimes U(6)$. The largest members of this chain are intrinsically broken; i.e., there does not exist a total Lagrangian that

posseses W_6 symmetry, since the kinetic energy and mass terms will automatically break it. The symmetry will make sense in terms of a strong-coupling limit.

1134

Institute for Advanced Study, Princeton, N. J.

METHOD OF THE SELF-CONSISTENT FIELD GENERAL RELATIVITY AND ITS APPLICATION TO THE GRAVITATIONAL GEON, by J. B. Hartle and D. R. Brill. [1964] [8]p. (AFOSR-65-0145) (AF AFOSR-64-42) AD 611486   Unclassified

Also published in Phys. Rev., v. 135: B271-B278, 1964.

Concentrations of radiation held together for a long time by their own gravitational attraction ('geons') have been studied for nearly a decade. The previous analyses are extended to the case where gravitational waves are the source of the geon's mass energy. To analyze these solutions of the free-space Einstein equations with persistent features, an approximation method is developed to treat small ripples on a strongly curved background metric. The background metric describes the large-scale persistent features of the geon and is taken to be spherically symmetric. The waves superimposed on this background have an amplitude small enough to so that their dynamics can be analyzed in the linear approximation; however, their wavelength is so short, and their time dependence so rapid that their energy is appreciable and produces the strongly curved background metric in which they move. The Einstein equations are investigated in this limit of short wavelength. It is found that the large-scale features of thin-shell spherical gravitational geons-in fact, of thin-shell spherical geons constructed from any field of zero rest mass-are identical to those of the spherical electromagnetic geons analyzed previously.

1135

Institute for Advanced Study, Princeton, N. J.

LARGE SYMMETRY BREAKING AND MASS RELATIONS, by C.-H. Woo. [1964] [4]p. (AFOSR-64-0147) (AF AFOSR-64-42) AD 611489   Unclassified

Also published in Phys. Rev., v. 135: B1352-B1355, Sept. 21, 1964.

The effects of symmetry breaking on the multiplet structure of composite particles are studied. The Sakata triplet is used for illustrations, and simple special models are studied where some mass regularities remain even in the presence of a fairly large symmetry breaking.

1136

Institute for Advanced Study, Princeton, N. J.

SCALAR DI-PION RESONANCE AND THE NUCLEON

AXIAL FORM FACTOR, by C.-H. Woo. [1964] [3]p. (AFOSR-65-0148) (AF AFOSR-64-42) AD 611488
                              Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 308-310, Mar. 16, 1964.

It is shown that the inclusion of a scalar di-pion resonance at m = 400 mev and γ = 50 mev can improve the agreement between theoretical and experimental information on the nucleon axial form factor.

1137

Institute for Advanced Study, Princeton, N. J.

CONNECTION BETWEEN THE ASYMPTOTIC BEHAVIOR AND THE SIGN OF THE DISCONTINUITY IN ONE-DIMENSIONAL DISPERSION RELATIONS, by Y. S. Jin and A. Martin. [1964] [6]p. (AFOSR-65-0150) (AF AFOSR-64-42) AD 611483   Unclassified

Also published in Phys. Rev., v. 135: B1369-B1374, Sept. 21, 1964.

Starting from one-dimensional dispersion relations (either fixed-transfer or partial-wave), information on the sign of absorptive part which follows from unitarity, and in some cases analyticity in the Mandelstam ellipse in the t plane and polynomial boundedness, we derive various consequences of physical interest, e.g., a high-energy lower bound on the forward scattering amplitude, the minimum fluctuation of the sign of the discontinuity across the left-hand cut in the partial-wave dispersion relations, etc. In the derivations, the positiveness of the absorptive part plays an essential role by allowing us to construct a Herglotz function which has a well-known asymptotic behavior.

1138

Institute for Advanced Study, Princeton, N. J.

NUMBER OF SUBTRACTIONS IN FIXED-TRANSFER DISPERSION RELATIONS, by Y. S. Jin and A. Martin. [1964] [3]p. (AFOSR-65-0151) (AF AFOSR-64-42) AD 611491   Unclassified

Also published in Phys. Rev., v. 135: B1375-B1377, Sept. 21, 1964.

Assuming the minimal requirements necessary to derive the Froissart bound, the number of subtractions for the fixed-momentum-transfer dispersion relation in the unphysical region $0 < t < 4\ \mu^2$ turns out to be 2. In the proof, the positiveness of all the derivatives of absorptive part with respect to t at t = 0 is used. Physical implications and applications of this result are briefly discussed.

1139

Institute for Scientific Information, Philadelphia, Pa.

THE USE OF CITATION DATA IN WRITING THE

HISTORY OF SCIENCE, by E. Garfield, I. H. Sher, and R. J. Torpie. Final rept. Dec. 31, 1964, 1v. incl. diagrs. tables. (AFOSR-65-1317) (AF 49(638)1256) AD 466578   Unclassified

A study is reported which tested the hypothesis that citation indexes are useful heuristic tools for the historian. In this approach, the history of science is regarded as a chronological sequence of events in which each new discovery is dependent upon earlier discoveries. Models of history were constructed consisting of chronological maps or topological network diagrams. Two such models were used here. The first is based on the events in the history of DNA as described by Dr. Isaac Asimov in The Genetic Code. The second is based on the bibliographic citation data contained in the documents which are the original published studies of events represented in the Asimov book. The interdependences of linkages among 40 major events (nodes) included in both network diagrams were mapped and compared. The study confirmed 65% (28 of 43) of the historical dependencies in the Asimov network by corresponding linkages established by citations. In addition, 31 citation connections were found which did not correspond to any historical dependencies noted in The Genetic Code.

1140

Institute for Scientific Information, Philadelphia, Pa.

MECHANIZED INDEXING METHODS AND THEIR TESTING, by J. O'Connor. Nov. 1963, 13p. (AFOSR-5154) (AF AFOSR-62-257) AD 611613   Unclassified

Also published in Jour. Assoc. Comput. Machinery, v. 11: 437-439, Oct. 1964.

Methods of mechanized indexing (subject indexing by computer) which have been proposed are systematically summarized. Every suggested method consists of some document preparation process mostly or wholly mechanical) followed by the application of indexing rules to the prepared document. A comprehensive document preparation is described from which proposed methods can be derived by selection. It includes full text input, document place (title, abstract, etc.) marking, sentence and paragraph marking, pronoun replacement, and other syntactic marking. It also includes addition of thesaurus headings, position numbers, weighted frequencies, closely associated expressions, importance measures, and reference information.

1141

Institute for Scientific Information, Philadelphia, Pa.

CORRELATION OF INDEXING HEADINGS AND TITLE WORDS IN THREE MEDICAL INDEXING SYSTEMS, by J. O'Connor. [1964] [10]p. incl. tables. (AFOSR-34-1389) (AF AFOSR-62-257) AD 444452
                                                Unclassified

Also published in Amer. Doc., v. 15: 96-104, Apr. 1964.

The Montgomery-Swanson study of Index Medicus heading-title correlations is discussed. Some presently unanswered questions relevant to practical use of their automatic indexing technique are indicated. Contrasted with the 86% heading-title correlation figure which they found for Index Medicus are the following ranges (based on small samples): Index-Handbook of Cardiovascular Agents: 19-45%; Merck Sharp and Dohme Retrieval System: 40-68%; NIH Research Grants Index: 13-39%. (Contractor's abstract)

1142

Instituto de Investigacion de Ciencias Biologicas, Montevideo (Uruguay).

[NEUROBIOLOGY, CELL ULTRASTRUCTURE, BIOPHYSICS AND ELECTROPHYSIOLOGY] by J. Sas, C. Appeltauer and others. Annual final rept. 1963-1964 [10]p. (AFOSR-64-1434) (AF AFOSR-63-313) AD 604470   Unclassified

Reports on the following topics are summarized: neurobiology, cell ultrastructure, nerve regeneration, and conditioned reflexes.

1143

Instituto de Investigaciones Cerebrales, Mexico City, Mex.

SLEEP INDUCING MECHANISMS, by R. Hernandez-Peon. Final technical rept. Mar. 1964, 27p. (AFOSR-64-0735) (AF AFOSR-62-364) AD 436525
                                                Unclassified

The behavioral and electrographic effects produced by the intracerebral application of minute crystals of various chemical substrates were studied in cats with descending cannulae permanently implanted in their brains. An extensive exploration was made from the most rostral part of the forebrain to caudal parts of the hindbrain. It was found that acetylcholine alone, or plus eserine, and carbachol elicited the two stages of sleep when applied to any point of a highly circumscribed anatomical pathway.

1144

Instituto de Investigaciones Cerebrales, Mexico City, Mex.

CHOLINERGIC PATHWAYS FOR SLEEP, ALERTNESS AND RAGE IN THE LIMBIC MIDBRAIN CIRCUIT, by R. Hernandez-Peon, G. Chavez-Ibarra and others. 1963, 4p. (AFOSR-64-0741) (AF AFOSR-62-364) AD 436506   Unclassified

Also published in Acta Neural Latinoamer., v. 8: 93-96, 1962.

In cats with cannulae permanently implanted in the brain, cholinergic stimulation evoked: (1) sleep along the limbic forebrain-limbic midbrain circuitry; medial forebrain bundle lesions posterior to previously tested

hypnogenic sites blocked cholinergic sleep; (2) alertness from septum to mesencephalic reticular formation via dorsal hypothalamus; (3) rage from septum to periaqueductal grey substance; and (4) autonomic and motor effects from loci immediately above and below hypnogenic pathways.

1145

Instituto de Neurologia, Montevideo (Uruguay).

ATTENTION, HABITUATION AND CONDITIONING AS RELATED TO THE BRAIN WAVES, by E. Garcia-Austt, J. Bogacz and others. Final technical rept. May 1, 1960-Apr. 30, 1964, 15p. incl. refs. (AFOSR-64-1841) (AF AFOSR-63-312) AD 607374   Unclassified

The primary aim of the research program was to obtain an objective appreciation of the time pattern of attention, habituation and other forms of learning in man. The second aim was to study the mechanism of this sensory control. Two possibilities, which do not exclude each other, were suggested: (1) a direct inhibltory action upon the specific pathways from the receptor up to the cerebral cortex, and (2) an indirect centrifugal action through the muscular mechanism regulating the energy of the stimulus. It was proposed to determine the role of the pupillary and ocular muscles in visual evoked response changes.

1146

Instituto de Neurologia, Montevideo (Uruguay).

CENTRIFUGAL CONTROL OF COCHLEAR INFLOW, by R. Vellutl, W. Buno, and E. Garcia-Austt. [1964] [1]p. (AFOSR-65-0966) (AF AFOSR-63-312) AD 618260   Unclassified

Also published in Proc. Sixth Cong. of the Latinamer. Assoc. of Physiol. Sci., Vina del Mar (Chile), Nov. 23-28, 1964, p. 95.

Results are presented for 59 experiments conducted on 42 guinea-pigs. The guinea-pigs were awake and free, with permanent electrodes implanted in the middle ear near the round window. In most experiments the earbones were removed, and the acoustic stimuli was delivered by an earphone connected to the middle ear through an implanted tube. Cochlear microphones and action potentials of the auditory nerve were recorded on magnetic tape. Continuous averaging of 35 to 40 responses was performed with a photo-optic-electronic method.

1147

Instituto de Quimica Fisica, Madrid (Spain).

SURFACE REACTION OF IRON WITH THIO- AND PHOSPHORUS-ORGANIC COMPOUNDS DISSOLVED IN HYDROCARBONS, by J. Llopis, J. M. Gamboa and others. Apr. 30, 1963, 105p. (AF 61(052)523) AD 412357   Unclassified

The use of compounds labelled with S-35 or P-32 permits the study of the surface interaction of extreme pressure lubrication additives with Fe. Hexadecane has been used as solvent. The efficiency of the radiochemical method has been emphasized. In the work here described, the behavior of a series of butyl sulphides and polysulphides up to the tetrasulphide has been studied. A mechanism to explain the surface reaction has been postulated, taking into account the lability of the S atoms in the molecules. The presence of oxygen increases the reactivity of mono- and disulphides, but decreases that of the mercaptans, this diminution being more important in the case of tri- and tetrasulphides. A mechanism to explain the action of oxygen in this sulphuration reaction has been proposed. The behavior with Fe of tricresyl phosphate and tributyl phosphite has been studied. In both cases a decisive influence of oxygen in the kinetics of the surface reaction has been observed.

1148

Instituto Geofisico de Huancayo, Lima (Peru).

PRELIMINARY MEASUREMENT OF H-ALPHA FLARE SPECTROGRAMS, by M. Ishitsuka, O. Takahashi and others. Feb. 1963, 22p. (AF 49(638)637) AD 437506   Unclassified

A spectrograph for observing solar flare spectra is being built. With the spectrograph, 22 spectrograms were taken successively with short time intervals, in a narrow spectral region centered in the hydrogen H-alpha line, throughout a solar flare event detected on Sept. 7, 1962. Several of the spectrograms were traced with a microphotometer. Observed profiles are compared.

1149

Instituto Geografico y Catastral. Observatorio Central Geofisico, Toledo (Spain).

CRUSTAL PHASES ACROSS THE IBERIAN PENINSULA REGION, by G. Payo. [1964] [23]p. incl. diagrs. table, refs. (AFOSR-65-2037) (AF 61(052)657) AD 616016   Unclassified

Also published in Ann. Geofisica (Rome), v. 17: 523-545, 1964.

A large collection of seismograms from near earthquakes recorded at Toledo Observatory have been revised in order to get the characteristics of the crustal phases for the Iberian Peninsula Region. After a careful determination of the parameters of the earthquakes, by using all the Spanish Seismological Stations, 39 of them have been selected and grouped in three characteristic groups corresponding to the regions named Algeria, Alboran Sea and rest of the Peninsula, which have been studied comparatively.

1150

Instituto Geografico y Catastral. Observatorio Central
Geofisico, Toledo (Spain).

A SEISMIC PROBABILITY MAP, by J. M. Munuera.
[1964] [15]p. incl. diagrs. tables, refs. (AFOSR-65-
2248) (AF 61(052)657)   Unclassified

Also published in Ann. Geofis. (Rome), v. 17: 547-
561, 1964.

The material included in two former papers which sums
3307 shocks corresponding to 2360 years, up to 1960,
was reduced to a 50 years period by means of the weight
obtained for each epoch. The weighting factor is the
ratio 50 and the amount of years for every epoch. The
frequency has been referred over basis VII of the in
ternational seismic scale of intensity, for all cases in
which the earthquakes are equal or greater than VI and
up to IX. The sum of products: frequency and parame-
ters previously exposed, is the probable frequency ex-
pected for the 50 years period.

1151

Instituto Geografico y Catastral. [Observatorio Central
Geofisico] Toledo (Spain).

[BACKGROUND NOISE ON THE S.S.S. STANDARD IN-
STRUMENTS] Ruido de Fondo en los Sismógrafos
Standard del Servicio de Sismología, by A. Lopez
Arroyo. 1964, 1v. incl. diagrs. tables, refs.
(AFOSR-65-2318) (AF 61(052)657) AD 628023
                                  Unclassified

A study of noise observed on the Toledo and Malaga
seismographs of the World-wide Standardized Seismo-
graph Network is given. For both sets of instruments,
LP and SP, the noise is classified in microseisms and
disturbances. The spectrum of LP and SP micro-
seisms is obtained and compared with previous data.
A minimum of the amplitude in the neighborhood of 2
cps, already observed at many sites of the USA, is
also shown for Toledo and Malaga; whereas the maxi-
mum of the spectrum around 4 - 8 sec, established by
Brune and Oliver and considered by them as a major
result of observational seismology is not clearly de-
fined. Annual variation of microseismic period and
amplitude is analyzed and the ratio AH/AZ derived;
Observation shows the existence of a predominant
period of microseisms at the two places considered.

1152

Instituto Nacional de Tecnica Aeroespacial, Madrid
(Spain).

COMBUSTION OF SOLID PROPELLANTS AND
FLAMES STRUCTURES, by C. Sanchez Tarifa. Final
rept. Apr. 1, 1962-Apr. 1, 1963, 1v. (AFOSR-5216)
(AF EOAR-62-90) AD 416546   Unclassified

Work on combustion of solid double-base propellants
has been finished. The studies on flames structures,
which comprise the hydrogen-oxygen flame with spheri-

cal symmetry, will be continued. In the last part of
the program studies on heterogeneous combustion
processes were initiated. They comprise the study of
two-dimensional flame propagation in liquid fuels; igni-
tion and combustion of liquid layers and ignition proper-
ties of inhibited fuel mists.

1153

Instituto Nacional de Tecnica Aeroespacial, Madrid
(Spain).

UNIDIMENSIONAL THEORY OF SUPERSONIC COMBUS-
TION, by I. Da-Riva. May 1, 1963, 22p. (AFOSR-
5260) (AF EOAR-62-91) AD 416526   Unclassified

This paper outlines a generalized unidimensional theory
of supersonic combustion. It considers a stream of oxi-
dizer flowing along a tube with lateral fuel supply gov-
erned by a certain injection law and the combustion
occurring in conditions in which the pressure is kept
constant. The principal results obtained by using the
simple model under consideration are: (1) If the inject-
ing of fuel does not impart kinetic energy to the flow,
the mixing process, even supposing it takes place in
ideal conditions, appreciably lowers the upper limit to
the practicability of supersonic combustion (the dissoci-
ation limit). (2) As for the lengths required for com-
bustion to take place, the estimate arrived at by this
method is practically the same as that obtained by as-
suming that the mixing and the reaction are two inde-
pendent processes. (3) In most of the cases considered
the diffusion governs the process; in other words, the
flow is closer to chemical-equilibrium than to frozen-
flow conditions.

1154

Instituto Nacional de Tecnica Aeroespacial, Madrid
(Spain).

ON THE STRUCTURE OF LAMINAR DIFFUSION
FLAMES, by A. Linan. June 1, 1963, 40p. incl.
diagrs. refs. (Technical rept. no. FM 63-2)
(AF EOAR-63-43) AD 437646; AD 432822
                                  Unclassified

The structure of laminar diffusion flames is analyzed
in the limiting case of large, although finite, reaction
rates. It is shown that the chemical reaction takes
place only in a very thin region or chemical boundary
layer where convection effects may be neglected. Then
the temperature and mass fraction distributions within
the reaction zone are obtained analytically. The flame
position, rates of fuel consumption, and temperature
and concentration distributions outside of the reaction
zone may be obtained by using the assumption of infi-
nite reaction rates. For large Reynolds numbers mix-
ing and combustion take place in boundary layers and
free mixing layers. And again analytical solutions are
obtained for the temperature and mass fraction distri-
butions outside of the reaction zone.

1155

Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).

SOME RESULTS IN SUPERSONIC COMBUSTION, by I. Da-Riva, A. Linan and E. Fraga. [1964] [28]p. incl. diagrs. refs. (AFOSR-64-2026) (AF EOAR-63-43) AD 451191   Unclassified

Presented at Internat'l. Council of the Aeronautical Sciences Fourth Cong., Paris (France), Aug. 24-28, 1964.

Some basic aspects of supersonic combustion are discussed, concerning the use of airbreathing engines for the propulsion of space vehicles within the atmosphere. The advantages and drawbacks of using diffusion flames for supersonic combustion are discussed. An analysis of the supersonic turbulent mixing process is included. The influence on the flow field of the heat addition due to the diffusion flame is also analyzed. Finally, chemical kinetic nonequilibrium effects with special emphasis on flame extinction are treated by considering, first, the laminar diffusion case and, afterwards, a tentative extension to the turbulent case.

1156

Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).

FIFTH AFOSR CONTRACTORS' MEETING ON CHEMICAL KINETICS OF PROPULSION; ABSTRACTS OF PAPERS, Madrid (Spain), Sept. 2-4, 1964. [1964] 45p. (AFOSR-65-1268) (AF EOAR-63-43) AD 622582   Unclassified

Abstracts are presented for twenty-two papers presented at the Fifth AFOSR Contractors' Meeting on Chemical Kinetics of Propulsion. Topics covered are mainly concerned with the combustion and reaction processes of propellant systems.

1157

Instituto Tecnologico de Aeronautica, Sao Paulo (Brazil).

EXPERIMENTS WITH AN EXTERNAL JET FLAP, by M. J. Krieger. [1963] 36p. incl. illus. diagrs. (AFOSR-4730) (AF 49(638)583) AD 407051   Unclassified

A study was made of several external-jet-flap configurations, tested between end plates in a blower-type wind tunnel. Comparison is also made with a trailing edge jet flap tested under the same conditons. Tests were made at a Reynolds number of 1.7×10^5 and at jet momentum coefficients up to 2.616, through a range of angles of attack from 0 to 35°. (Contractor's abstract)

1158

International Business Machines Corp. [Thomas J. Watson Research Center] Yorktown Heights, N. Y.

A THEORY OF NONLINEAR NETWORKS, II, by R. K. Brayton and J. K. Moser. [1964] [24]p. incl. diagrs. refs. (AFOSR-64-1818) (AF 49(638)1139) AD 449257   Unclassified

Also published in Quart. Appl. Math., v. 22: 81-104, July 1964.

In this paper the existence and the form of the mixed potential function for complete electrical networks is derived using a graph theoretic approach. Some well-known results for electrical networks are discussed and rederived starting with the existence of a mixed potential function. In the last section a theorem on the existence of periodic solutions for periodically excited nonlinear circuits is proved.

1159

International Business Machines Corp. [Thomas J. Watson Research Center] Yorktown Heights, N. Y.

STABILITY CRITERIA FOR LARGE NETWORKS, by R. K. Brayton. [1964] [5]p. incl. diagrs. (AFOSR-64-2319) (AF 49(638)1139) AD 452428   Unclassified

Also published in IBM Jour. Research and Development, v. 8: 466-470, Sept. 1964.

An arbitrarily large network of bistable tunnel diode switching circuits is analyzed for stability. One condition derived indicates that increasing the total 'fan' of each circuit might tend to make the whole network unstable. This condition is independent of the tunnel-diode characteristic. Another condition is also derived which depends on this characteristic but does not involve the total 'fan'. Finally, two general theorems which were proved in another paper are stated and discussed in terms of their applicability to certain classes of large networks and of the types of conditions for stability that can be obtained.

1160

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

ON THE EFFECT OF COMPONENT TOLERANCES IN THE BALANCED-PAIR TUNNEL-DIODE CIRCUIT, by R. K. Brayton. [1964] [6]p. incl. diagrs. (AFOSR-64-2320) (AF 49(638)1139) AD 452313   Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-11: 351-356, Sept. 1964.

The purposes of this study are (1) to determine for the balanced-pair tunnel-diode circuit the minimum amount of control required when specified parameter imbalances are present and (2) to illustrate a method of analysis using perturbation theory which can be applied to nonlinear, almost symmetrical circuits.

1181

International Business Machines Corp. Thomas J. Watson
Research Center, Yorktown Heights, N. Y.

A STABILITY THEORY FOR NONLINEAR MIXED INI-
TIAL BOUNDARY VALUE PROBLEMS, by R. K.
Bra tou and W. L. Miranker. (AFOSR-85-1023)
(AF 49(638)1139) AD 818851   Unclassified

Also published in Arch. Rational Mech. and Anal.,
v. 17: 358-376, 1964.

The notion is discussed of complete stability of mixed
initial boundary problems for systems of partial dif-
ferential equations, either linear or nonlinear. A
method of constructing Liapunov functionals is given
from which the stability statement is obtained. A
theorem is then presented which shows that complete
stability follows from the existence of a Liapunov func-
tional. A number of examples are presented.

1162

International Business Machines Corp. Thomas J. Watson
Research Center, Yorktown Heights, N. Y.

SOLID TRANSPORT RATE IN THE VAPOR-SOLVENT
GROWTH SYSTEM ZnS:I, by F. Jona and G. Mandel.
[1964] [4]p. (AFOSR-64-1251) (AF 49(638)1201)
AD 442819   Unclassified

Also published in Jour. Phys. and Chem. Solids, v.
25: 187-190, 1964.

Measurements of the rate of solid transport have been
carried out in the system ZnS:I with two different
sealed-tube geometries. The cubic ZnS crystals ob-
tained are comparable in size and quality to those
grown from HCl. With increasing pressure, the trans-
port mechanism is at first diffusion-then convection
controlled. In the range of diffusive flow, the perti-
nent theory for multireaction multi-component systems
is in satisfactory agreement with the experimental data.

1163

International Business Machines Corp. Thomas J. Watson
Research Center, Yorktown Heights, N. J.

CHEMICAL EQUILIBRIA IN THE GERMANIUM-IODINE
AND GERMANIUM-BROMINE SYSTEMS BY WEIGHT-
LOSS MEASUREMENTS, by F. Jona, R. F. Lever,
and H. R. Wendt. [1964] [5]p. (AFOSR-64-1252)
(AF 49(638)1201) AD 442813   Unclassified

Also published in Jour. Electrochem. Soc., v. 111:
413-417, Apr. 1964.

Simple heterogeneous equilibria can be elucidated by
determining the total amount of solid that goes in the
gas phase under the action of a known amount of gaseous
solvent at a given temperature. This method was
first tested satisfactorily with the germanium-iodine
system, for which thermodynamic data are already
available, and then applied to the germanium-bromine

system. The data make it possible to calculate the ra-
tio between total density of germanium atoms and total
density of halogen atoms in the gas phase within a wide
range of temperatures and pressures. These calcula-
tions enable one to predict the direction and the amount
of diffusive vapor transport in closed or open vapor
growth systems.

1164

International Business Machines Corp. Thomas J. Watson
Research Center, Yorktown Heights, N. Y.

THE EQUILIBRIUM BEHAVIOR OF THE SILICON-
HYDROGEN-CHLORINE SYSTEM, by R. F. Lever.
[1964] [8]p. (AFOSR-64-2105) (AF 49(838)1201)
AD 451735   Unclassified

Also published in IBM Jour. Research and Development,
v. 8: 460-465, Sept. 1964.

The composition of the gas phase is calculated for vari-
ous temperatures, pressures, and chlorine-to-hydrogen
ratios for the two-phase system consisting of solid
silicon in equilibrium with the gas phase. It is shown
that in the range of variables most frequently used for
vapor growth of silicon, the principal species under
equilibrium conditions are H_2, HCl, $SiHCl_3$, and $SiCl_2$.

1185

International Business Machines Corp. Thomas J. Watson
Research Center, Yorktown Heights, N. Y.

APPLICATION OF SPIN-WAVE THEORY TO EuS, by
S. H. Charap and E. L. Boyd. [1964] [8]p. (AFOSR-
84-1201) (AF 49(638)1230) AD 443010   Unclassified

Also published in Phys. Rev., v. 133: 811-818, Feb. 3,
1964.

Magnetization data for EuS powder in zero field and at
liquid-helium temperatures has been obtained by nuclear
magnetic resonance of both the Eu^{151} and Eu^{153} nuclei.

1188

International Business Machines Corp. Thomas J. Watson
Research Center, Yorktown Heights, N. Y.

EPR OF EXCHANGE-COUPLED PAIRS OF Eu^2 IN CaO
AND SrO, by B. A. Calhoun and J. Overmeyer. [1964]
[2]p. (AFOSR-84-1202) (AF 49(638)1230) AD 443011
                                        Unclassified

Also published in Jour. Appl. Phys., v. 35: 989-990,
Mar. 1964.

The EPR spectra of isolated Eu^{2+} ions have been studied
in crystals of CaO and SrO. The g values and hyperfine
constants are the same in both crystals. The values
for the exchange interactions agree with those inferred
from the magnetic properties of the europium chalcoge-
nites.

1167

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

SPECIFIC HEAT OF EuS, by V. L. Moruzzi and D. T. Teaney. [1963] [5]p. (AFOSR-64-1203) (AF 49(638)-1230) AD 443013   Unclassified

Also published in Solid State Commun., v. 1: 127-131, 1963.

Specific heat measurements of EuS between 10 and 35°K show a sharp peak at 16.2°K. The measurements are analyzed using the constant coupling approximation, and it is shown that the dominant exchange interaction is between nearest neighbor Eu^{++} ions.

1168

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

FERROMAGNETIC EUROPIUM COMPOUNDS, by T. R. McGuire and M. W. Shafer. [1964] [5]p. (AFOSR-64-1205) (AF 49(638)1230) AD 443014   Unclassified

Also published in Jour. Appl. Phys., v. 35: 984-988, Mar. 1964.

Ferromagnetism has been found in several divalent europium compounds. The materials investigated can be divided into three groups, europium chalcogenides, europium halogens, and europium silicates. Magnetic information on these compounds are summarized and theoretical results reviewed.

1169

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

MAGNETIC RESONANCE STUDIES OF THE CUBIC ANTIFERROMAGNET $RbMnF_3$, by M. J. Freiser, R. J. Joenk and others. [1964] [5]p. incl. diagrs. (AFOSR-65-1985) (AF 49(638)1379) AD 627200   Unclassified

Also published in Proc. Internat'l. Conf. on Magnetism, Nottingham (Gt. Brit.), Sept. 7-11, 1964, p. 432-436.

The properties of the cubic antiferromagnet $RbMnF_3$ are studied by means of antiferromagnetic resonance and Mn^{55} nuclear resonance. The possibility of observing non-linear interactions between the two antiferromagnetic resonance modes is discussed. The temperature variation of the anisotropy has been measured up to 77°K. It has been found to agree within experimental error with Wolf's molecular field treatment of the dependence of K on M and with the assumption that $M/M_0 = B_{5/2}(T/T_N)$ with $T_N = 82.6°$ as obtained from specific heat measurements. The nuclear magnetic resonance measurements are refined and extended to

applied fields of 27kOe yielding a value of the unpulled nuclear magnetic resonance frequency of 686.2 mc/sec. The half-width at half-maximum is independent of field at fields large enough to eliminate domain effects and is found to be 280 kc/sec, about an order of magnitude less than the Suhl-Nakamura linewidth. An as yet unexplained anomaly occurs when the pulled nuclear frequency is 680 mc/sec.

1170

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

MAGNETIC PARAMETERS IN NiF_2, by R. J. Joenk and R. M. Bozorth. [1964] [4]p. incl. diagrs. table. (AFOSR-65-2581) (AF 49(638)1379) AD 629293   Unclassified

Also published in Proc. Internat'l. Conf. on Magnetism, Nottingham (Gt. Brit.), Sept. 7-11, 1964, p. 493-496.

Using the Moriya model of weak ferromagnetism in NiF_2 we have derived from magnetic measurements the various parameters: the canting angle of the spin $\varphi_0 = 0°39'$ and the anisotropy field $H_M = 15.3$ kOe that causes it, the axial anisotropy field $H_A = 36.9$ kOe that maintains the antiferromagnetic vectors perpendicular to the tetragonal axis, the exchange field $H_E = 1130$ kOe and the splitting factor $\bar{g} = 2.31$. These quantities are obtained from measurements of moment as a function of field and temperature with the additional use of the antiferromagnetic resonance data of Richards, confirmed by Wheeler, to fix the constant H_A. (Contractor's abstract)

1171

Iowa State U. Dept. of Chemistry, Ames.

REACTIONS OF RESONANCE STABILIZED ANIONS. PART IX. CONDENSATIONS OF AROMATIC ALDEHYDES IN DIMETHYL SULFOXIDE SOLUTION. PART X. PREPARATION AND PUMMERER REARRANGEMENT OF β-KETOSULFOXIDES, by G. A. Russell, H.-D. Becker, and G. J. Mikol. [1963] [9]p. incl. diagrs. tables, refs. (AFOSR-64-0128) (AF AFOSR-63-38) AD 431075   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 3406-3414, Nov. 5, 1963.

An asymmetric tricarbon condensation involving an aromatic aldehyde diphenylmethane, and the solvent dimethyl sulfoxide has been found to occur in the presence of potassium t-butoxide. The condensation product readily undergoes an elimination reaction to yield either of two isomeric triarylpropenes. The mechanism of the condensation reaction has been established by isolation of all probable intermediates. The preparation of β-ketosulfoxides from aromatic esters and dimethyl sulfoxide is described. Acid-catalyzed rearrangement of these β-ketosulfoxides leads to the formation of methyl hemimercaptals of α-ketoaldehydes.

1172

Iowa State U. Dept. of Chemistry, Ames.

NATURE OF THE POLAR EFFECT IN REACTIONS OF ATOMS AND RADICALS. II. REACTION OF CHLORINE ATOMS AND PEROXY RADICALS, by G. A. Russell and R. C. Williamson, Jr. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1504) (AF AFOSR-63-38) AD 446120   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2357-2364, June 20, 1964.

The attack of chlorine atoms upon substituted toluenes and of peroxy radicals upon substituted cumenes has been found to show a polar effect best correlated by σ^+ constants. Polar effects in the oxidation of substituted styrenes were found, but the rates of autooxidation of benzyl phenyl ethers were found to be insensitive to the nature of substituents. No polar effect could be found when the reactivities of styrenyl and p-nitrostyrenyl radicals toward molecular oxygen were compared.

1173

Iowa State U. Dept. of Chemistry, Ames.

DIRECTIVE EFFECTS IN ALIPHATIC SUBSTITUTIONS XXV. REACTIVITY OF ARALKANES, ARALKENES, AND BENZYLIC ETHERS TOWARD PEROXY RADICALS, by G. A. Russell and R. C. Williamson, Jr. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-64-1505) (AF AFOSR-63-38) AD 446120   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2364-2367, June 20, 1967.

The competitive oxidation of a number of aralkanes, aralkenes, and benzyl ethers has been performed and their reactivities toward the derived peroxy radicals measured. The reactivities are fairly independent of the structure of R in ROO. To explain the rates of oxidation of the pure compounds, it must be assumed that termination rate constants are dependent upon the structures of the peroxy radicals. This observation is consistent with the rate minima observed in the autooxidation of numerous binary mixtures.

1174

Iowa State U. Dept. of Physics, Ames.

SOUND DISPERSION IN SUBSTITUTED METHANE-INERT GAS MIXTURES, by J. R. Olson and S. Legvold. [1963] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0260) (AF AFOSR-62-319) AD 437086
                                        Unclassified

Also published in Jour. Chem. Phys., v. 39: 2902-2908, Dec. 1, 1963.

Binary halomethane-noble gas mixtures were examined ultrasonically. The methanes used were CF_4 CHF_3,

and CCl_2F_2 and the noble gases were Ar, Ne, and He. Results obtained show that the reciprocal relaxation times for these mixtures vary linearly with the concentration. Also, Ar-X collisions are less effective, He-X collisions are much more effective, and Ne-X collisions differ little from X-X collisions in vibrational energy transfer. X represents the dispersive gas. Theoretical values of Z_{10}^{AB}, the mean collision lifetime of an A molecule in an ortherwise pure gas of B molecules, were calculated according to the Schwartz, Slawsky, and Herzfeld theory. Intermolecular potentials appropriate for the treatment of the data were examined and it was found that the Lennard-Jones 6:12 potential was appropriate for the noble gases, and the 7:26 form was appropriate for the halomethanes. (Contractor's abstract)

1175

Iowa State U. Dept. of Physics, Ames.

SOUND ABSORPTION IN BINARY MIXTURES OF HALOMETHANE GASES, by M. L. Wang, R. R. Boade, and S. Legvold. [1964] [2]p. incl. diagr. table. (AFOSR-65-2626) (AF AFOSR-62-319) AD 628426   Unclassified

Also published in Jour. Chem. Phys., v. 41: 3679-3880, Dec. 15, 1964.

Results of sound absorption measurements on binary mixtures of CH_2F_2, CHF_3, CF_4 and CCl_2F_2 are given. The mixtures show no evidence of multiple dispersion. The observed relaxation times are discussed in relation to a theory of Calvert and Amme.

1176

Iowa State U. [Dept. of Mathematics] Iowa City.

RICCATI MATRIX DIFFERENTIAL EQUATIONS AND NON-OSCILLATION CRITERIA FOR ASSOCIATED LINEAR DIFFERENTIAL SYSTEMS, by W. T. Reid. [1963] [21]p. (AFOSR-J1271) (AF AFOSR-62-78) AD 424341   Unclassified

Also published in Pacific Jour. Math., v. 13: 665-685, 1963.

The purpose of the present paper is to study in more detail the concept of a principal solution of a non-oscillatory linear matrix differential system, together with related problems for the associated Riccati matrix equation. In particular, certain aspects considered previously in variational context only are here divorced from such limitations.

1177

Iowa State U. Dept. of Mathematics, Iowa City.

PRINCIPAL SOLUTIONS OF NONOSCILLATORY LINEAR DIFFERENTIAL SYSTEMS, by W. T. Reid.

[1964] [27]p. (AFOSR-65-0344) (AF AFOSR-63-438)
AD 612312   Unclassified

Also published in Jour. Math. Anal. and Appl., v. 9:
397-423, Dec. 1964.

A summary is presented of recent work done by the
authors in the methods of analysis of factorial designs,
including both fractional replications and confounded de-
signs. The general methods of analysis described here-
in not only facilitate the analysis in individual cases,
but also they throw light on possible methods of con-
structing designs with various desirable properties.

1178

Iowa State U. [Dept. of Physics and Astronomy]
Iowa City.

SIMULTANEOUS OBSERVABILITY AND THE LOGIC
OF QUANTUM MECHANICS, by J. C. T. Pool. June
1964, 1v. (Rept. no. SUI 63-17) (AFOSR-5268)
(AF AFOSR-62-122) AD 417667   Unclassified

The axiomatization of quantum mechanics formulated
by G. W. Mackey is based on several physically plausi-
ble axioms. Heuristic interpretations of the properties
of the collection of all observable quantities and the
collection of all states of a physical system motivate
these axioms. The axioms characterize a logical
structure consisting of a sigma-orthocomplete, ortho-
modular, orthocomplemented, partially ordered set,
called a logic, and a sigma-convex, sufficient set of
probability gages on the logic. The elements of the
logic, called questions, are interpreted as mathemati-
cal constructs representing the experimental proposi-
tions concerning the physical system, while each prob-
ability gage represents a possible state of the physical
system.

1179

Iowa State U. [Dept. of Physics and Astronomy]
Iowa City.

STATISTICAL THEORY OF ENERGY-LEVEL SPAC-
ING DISTRIBUTIONS FOR COMPLEX SPECTRA, by
H. S. Leff. June 1963, 194p. (Rept. no. SUI 63-23)
(AFOSR-5269) (AF AFOSR-62-122) AD 417373
                                             Unclassified

The present work includes four main objectives: (1)
to give precise mathematical definitions for the mth
order spacing distributions without specifying a particu-
lar ensemble, (2) to obtain a connection between en-
sembles of Hermitian matrices and ensembles of uni-
tary matrices, (3) to introduce an entire class of
'generalized' ensembles for which various statistical
properties can be calculated formally, and (4) to use
the formalism of (1) to find the mth order distributions
for series of levels with mixed spins and parities.

1180

Iowa State U. [Dept. of Physics and Astronomy]
Iowa City.

CONTRASTS AND CONFLICTS OF S-MATRIX AND
FIELD THEORY, by M. Dresden. June 1963, 48p.
(Rept. no. SUI 63-21) (AFOSR-5293) (AF AFOSR-62-
122) AD 419389   Unclassified

The framework of the various field theories is outlined
briefly. Since the motivation of the S-matrix approach
stems in part from a dissatisfaction with field theory,
it is important to examine the underlying assumptions
of the different field theories. There is a brief de-
scription of the assumptions made by Stapp ("The Stap-
plan Way") in his axiomatic discussion of S-matrix
theory. In addition to a description of the axioms,
there are also a number of remarks, comments, and
criticisms of these axioms. The S-matrix criticism of
the notions of usual field theory is re-examined as is
the manner in which the new postulates are supposed to
circumvent the field theoretic difficulties.

1181

Iowa State U. [Dept. of Physics and Astronomy]
Iowa City.

THE INFLUENCE OF INITIAL CORRELATIONS ON
THE APPROACH TO EQUILIBRIUM, by G. L. Jones.
Dec. 10, 1963, 8p. (AFOSR-64-1976) (AF AFOSR-
62-122) AD 452508   Unclassified

Also published in Jour. Math. Phys., v. 5: 651-658,
May 1964.

The irreversible behavior of a particle under the influ-
ence of fixed scattering centers is investigated in the
weak coupling limit. An ensemble is introduced which
statistically describes the scattering centers as well
as the particle. This allows the treatment of correla-
tions between the particle and the scattering centers.
A new diagrammatic method is used to investigate high-
order terms in the perturbation theory. This method
yields quite explicit information about the way in which
the influence of initial correlations will disappear. In
particular, it is quite clear that as one goes to higher
order in the perturbation theory one must wait longer
times for the influence of initial correlations to disap-
pear. For completeness, The Boltzmann equation is
derived and solved to lowest order in the interaction
strength.

1182

Iowa State U. [Dept. of Physics and Astronomy]
Iowa City.

APPLICATION OF NONLOCAL FIELD OPERATORS TO
A SYSTEM OF HARD-SPHERE BOSE, by K. W. Wong.
[1964] [6]p. (AFOSR-64-1968) (AF AFOSR-64-517)
AD 452501   Unclassified

Also published in Jour. Math. Phys., v. 5: 637-642,
May 1964.

Some relationships of the nonlocal field operators and the usual free-field operators are obtained. The interaction Hamiltonian derived with the help of these relationships is compared with the pseudopotential recently obtained by Liu and Wong. A study of the fluid dynamical equations at extreme low temperature has been made.

1183

Iowa State U. [Dept. of Physics and Astronomy] Iowa City.

CLASS OF ENSEMBLES IN THE STATISTICAL THEORY OF ENERGY-LEVEL SPECTRA, by H. S. Leff. [1964] [6]p. (AFOSR-64-1969) (AF AFOSR-64-517) AD 452502   Unclassified

Also published in Jour. Math. Phys., v. 5: 763-768 June 1964.

The investigation of a large class of ensembles in the statistical theory of energy-level spectra is initiated.

1184

Iowa State U. Dept. of Physics and Astronomy, Iowa City.

ON THE DEFINITION OF SCATTERING IN RELATIVISTIC QUANTUM FIELD THEORY, by R. Fong. [1964] [15]p. incl. refs. (AFOSR-65-0412) (AF AFOSR-64-517) AD 612309   Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1422-1436, Sept. 1, 1964.

A relativistic interacting theory for neutral bosons and in which there can be no stable bound states is studied. The theory is obtained by embedding two-particle relativistic quantum mechanics in quantum field theory by means of a procedure recently given by Sudarshan. This results in a theory in which there is scattering in the two-particle channel only. An 'interacting' field operator $\psi(x)$ is defined for the theory. It is then found that under the usual formulation of axiomatic quantum field theory $\psi(x)$ must be regarded as a 'local free-field operator'. However, there is inherent in $\psi(x)$ scattering information. A new asymptotic condition for field operators is then proposed, whereby this scattering information may be extracted. A heuristic discussion of the physical significance of the asymptotic condition is also given. (Contractor's abstract)

1185

Iowa State U. Dept. of Physics and Astronomy, Iowa City.

A METHOD OF SOLVING THE MANY-BODY K-MATRIX WITH A YUKAWA INTERACTION POTENTIAL, by K. W. Wong. [1964] [37]p. (AFOSR-65-0413) (AF AFOSR-64-517) AD 612310   Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 816-818, Nov. 1964.

The problem of solving the many-body K-matrix with a Yukawa potential can be formulated approximately into solving a potential of the form
$$\sum_{l=1}^{M} \sum_{l=0}^{\infty} \sum_{m=1}^{l}$$
$$a_{l}(k')b_{l}(k)Y_{lm}(k'|_{p})Y_{lm}^{*}(k|_{p}).$$ It is shown in this note how to approximate the matrix in terms of this finite series.

1186

Iowa State U. Dept. of Physics and Astronomy, Iowa City.

A METHOD OF SOLVING THE MANY-BODY K-MATRIX, by K. W. Wong. Nov. 1964 [8]p. incl. refs. (AFOSR-65-0414) (AF AFOSR-64-517) AD 612311   Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 591-598, Nov. 1, 1964.

The theory of many-body systems with strong interactions involves the problem of solving a K-matrix. This note discusses how to handle the K-matrix with an approximation method to the interaction potential. The classes of Bose statistics and Fermi statistics are treated. For the Fermi case the K-matrix equation with and without hole-hole interaction is considered.

1187

Iowa State U. Dept. of Physics and Astronomy, Iowa City.

HARD-SPHERE APPROACH TO THE EXCITATION SPECTRUM IN LIQUID HELIUM II, by L. Liu L. S. Liu, and K. W. Wong. [1964] [7]p. incl. diagrs. refs. (AFOSR-65-0415) (AF AFOSR-64-517) AD 612348   Unclassified

Also published in Phys. Rev., v. 135: A1166-A1172, Aug. 31, 1964.

The excitation spectrum of a Bose system of hard spheres is obtained in a high-density calculation including multiple scattering processes. The hard-sphere interaction is represented by a non-Hermitian pseudopotential constructed in a previous work, and the T-matrix method of Brueckner and Sawada is adopted with modifications to take into account the non-Hermitian property of the Hamiltonian. The inclusion of multiple scattering is found essentially to give a screening effect to the two-body interaction in a many-body medium. The screening factor is studied within certain approximations and is shown to play a very important role in determining the shape of the excitation spectrum. The effect of depletion of particles from the zero-momentum state due to particle interaction is also included in a self-consistent way and is found to be very small. The

calculated spectrum is then applied to liquid helium and there is a good qualitative agreement with experiments. Especially, a roton-type dip exists in the spectrum. (Contractor's abstract)

1188

Istituto Documentazione della Associazione Meccanica Italiana, Milan (Italy).

A PROJECT FOR AUTOMATIC SENTENCE ANALYSIS, by E. von Glasersfeld. [1964] [9]p. (AFOSR-65-0860) (AF EOAR-64-54) AD 617865 Unclassified

Also published in Beitrage Sprachkunde und Informationsverarbeitung, No. 4: 38-46, 1964.

The newly organized language research section of IDAM1 in Milan is conducting an experimental investigation on automatic English sentence analysis. This investigation has 2 purposes: (1) to elaborate and improve the automatic correlation procedure of von Glasersfeld and Burns, and implement it in a computer program by means of a "Multistore" system; and (2) to use syntactic correlation procedure to isolate semantic factors for the analysis or interpretation of the meaning of English sentences, and employ these semantic factors in the correlation procedure in order to reduce the output of semantically unacceptable sentence analysis.

1189

Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin (Italy).

[RESEARCH IN SOLID-STATE PHYSICS AT THE LABORATORY FOR ELECTRON MICROSCOPY OF THE ISTITUTO ELETTROTECNICO NAZIONALE] Richerche di fisica dei solidi presso il Laboratorio di Microscopia Elettronica dell'IEN, by G. Bonfiglioli. [1964] [12]p. incl. illus. diagrs. table. (AFOSR-65-0763) (AF 61(052)328) AD 616465 Unclassified

Also published in Fisica Stato Solido; Convegno indetto dello Società Lombarda di Fisica, Pavia (Italy) (July 16-18, 1962) 1964, p. 3-14.

Several subjects which have been or are being investigated at the laboratory are surveyed. First, alkali halide thermoluminescence above room temperature: a model is proposed, using a second order kinetics, that accounts well for a number of experimental results rather poorly explained by previous theories. Experiments are then mentioned on intrinsic electroluminescence of ZnS specimens, undergoing linear voltage transients. The results are compared with those predictable on the basis of a mathematical development of Zalm's theory. Electron microscopy studies of tracks of fission products in mica are discussed, and mention is made of experiments on surface electrical conductivity in metals.

1190

Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin (Italy).

GRAPHITE DEFECTS OBSERVED BY ELECTRON MICROSCOPY, by G. Bonfiglioli and A. Mojoni. Sept. 1963 [10]p. incl. illus. refs. (Technical note no. 1) (AFOSR-5436) (AF EOAR-63-87) Unclassified

Also published in Jour. Appl. Phys., v. 35: 683-685, Mar. 1964. (AFOSR-64-1214; AD 443020)

Structural defects of natural graphite are characterized by Newton-ring-like electron microscopic contrast. Pictures are given, evidencing their aspect, their peculiar distribution (often corresponding to linear alignment), and their behavior at high temperatures. A discussion is presented concerning related theoretical and experimental results of other authors and in particular the relationship of these defects to radiation damage.

1191

Istituto Elettrotecnico Nazionale [Galileo Ferraris] Turin (Italy).

Cu REPRECIPITATION AND ELECTROLUMINESCENCE IN ZnS SINGLE CRYSTALS, by G. Bonfiglioli and A. Suardo. [1964] [2]p. incl. illus. diagr. (AFOSR-65-0751) (AF EOAR-63-87) Unclassified

Also published in Phys. Ltrs., v. 13: 197-198, Dec. 1, 1964.

The results of this investigation demonstrate the occurrence of a large aging effect in Cu-doped electroluminescent ZnS single crystals. This suggests that the ac electroluminescent behavior of this material is influenced by reprecipitation of the cu-rich phase within the host matrix.

1192

Istituto Elettrotecnico Nazionale [Galileo Ferraris] Turin (Italy).

PRINCIPLES OF SELF-MODULATING DERIVATIVE OPTICAL SPECTROSCOPY, by G. Bonfiglioli and P. Brovetto. [1964] [8]p. incl. diagrs. table. (AFOSR-65-0752) (AF EOAR-63-87) AD 616457 Unclassified

Also published in Appl. Opt., v. 3: 1417-1424, Dec. 1964.

This paper presents the theoretical principles underlying a new technique of optical spectroscopy, characterized by the fact that the record of a spectrum, differentiated and efficiently purified of noise, is obtained in a direct and simple way. The interest of derivative optical spectroscopy is evidenced by calculations showing for a typical case the gain to be expected. A set of equations is then given showing the dependence of the new spectrometer performance on the principal design parameters. (Contractor's abstract)

1193

Istituto Nazionale di Ottica, Florence (Italy).

MUTUAL TIME INFLUENCE OF BLUE AND RED
ELECTRORETINOGRAPHIC RESPONSES, by A. M.
Ercoles. [1963] [8]p. (AFOSR-J641) (AF EOAR-63-4)
AD 414016   Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16:
239-246, Mar.-Apr. 1963.

Electroretinographic responses elicited by a sequence
of stimuli of constant duration with various frequen-
cies, are recorded from a dark adapted eye; for each
value of frequency three different types of stimulation
have been used; different types of stimulation have
been used; a sequence of blue flashes, a sequence of
red flashes and a sequence of blue and red flashes in
succession. The results show, for each type of stimu-
lation used, the expected decrease in amplitude of the
scotopic b-wave, either when the frequency of stimula-
tion increases or during each experimental set. The
point to be emphasized is that the above said decrease
in amplitude, in the case of combined red-blue stimula-
tion attains a value which differs with respect to those
recorded in the case of homo-chromatic stimulations.
In conclusion, the influence of blue stimulation on the
next red response is different with respect to that ex-
erted by red stimulation on the next blue response.

1194

Istituto Nazionale di Ottica, Florence (Italy).

RESEARCH ON RETINAL MECHANISMS AND RE-
SPONSES, by M. Bittini, A. M. Ercoles and others.
Oct. 31, 1963, 60p. (AFOSR-64-0103) (AF EOAR-
63-4) AD 429779   Unclassified

The present report is divided into the following six
parts: (a) The interactions between the responses to
visual stimuli stabilized on the retina; (b) The investi-
gation of the effects of the stimulation of one eye on
the ERG recorded from the other eye; (c) Some pecu-
liar interaction effects occurring under differential bi-
nocular adaptation; (d) The acquisition times relative
to the learning of various visual functions are report-
ed; (e) Some suprathreshold phenomena which find
their explanation in terms of retinal interaction effects
possibly mediated through lateral inhibition; (f) Some
irregularities of sensitivity to luminance differences
which are unexpected when the smooth behavior of the
Weber-Fechner function is taken in mind.

1195

Istituto Nazionale di Ottica, Florence (Italy).

ANALYSIS OF SHIFTS AND DEFLECTIONS OF BASE-
LINE IN ELECTRORETINOGRAPHIC RECORDS, by
L. Ronchi and G. Bottai. [1963] [29]p. (AFOSR-64-
1059) (AF EOAR-63-4) AD 441484   Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16:
617-645, Nov.-Dec. 1963.

All the events distorting the base line, in absence of
light stimulation, have been qualitatively and quantita-
tively analyzed. Their characteristics (such as size,
duration and rate of rise) have been compared to the
corresponding characteristics of assumed undistorted
ERG responses, and, in addition, the possible inter-
ferences between response to light and artifact have
been examined. The conclusion is that in some cases
ERG response is so distorted that it must be unavoida-
bly rejected; in some other cases the correction for dis-
tortion may be evaluated, and lastly, there are some
artifacts which are so brief that they may occur during
the course of ERG response without affecting the pre-
ceding and the following portions of baseline. Thus,
the availability of responses is strictly connected to the
degree of sophistication of the subject.

1196

Istituto Nazionale di Ottica, Florence (Italy).

SIMULTANEOUS CONTRAST EFFECTS AT THE CEN-
TER OF FIGURES SHOWING DIFFERENT DEGREES
OF SYMMETRY, by L. Ronchi and G. Bottai. [1964]
[17]p. (AFOSR-64-1060) (AF EOAR-63-4) AD 441506
                                      Unclassified

Also published in Atti Fondazione G. Ronchi, v. 19:
84-100, Jan.-Feb. 1964.

The brightness at the cross-point of two black stripes
of equal thicknesses intersecting with one another has
been measured under a number of experimental condi-
tions. The observer was well adapted to the luminance
of the background. In some cases a bright break or a
bright flash are perceived at the cross-zone; in some
other cases such an effect is not tested. In particular,
the degree of symmetry of the figure plays an important
role; the greater the degree of symmetry, the greater
the spatial fidelity of the visual system, as far as the
perception of the cross-point is concerned. Also the
length of the stripes plays an important role.

1197

Istituto Nazionale di Ottica, Florence (Italy).

CONTRAST SENSITIVITY AND SPEED OF READING
UNDER DIFFERENTIAL BINOCULAR ADAPTATION,
by L. Ronchi and M. Conticelli. [1964] [15]p.
(AFOSR-64-1061) (AF EOAR-63-4) AD 441507
                                      Unclassified

Also published in Atti Fondazione G. Ronchi, v. 19:
69-83, Jan.-Feb. 1963.

Two experiments are reported which show that differ-
ential binocular adaptation in some cases is advantage-
ous, with respect to the case where the eyes are adapt-
ed to the same level, in other cases it is not. More
precisely, when the dynamic aspect of the process of
adaptation to light is taken into account, visual per-
formance is lesser in the case where the two eyes are
simultaneously adapting to light than in the case where
they are adapting one after the other. When the static
aspect of adaptation is taken into account (and the

observer is presented with an empty field, in order to render the adaptational state as constant as possible), the greater performance is reported when the two eyes are adapted to the same level. The nature of the mechanism subserving the reported effect is discussed.

1198

Istituto Nazionale di Ottica, Florence (Italy).

VISUO-MOTOR REACTION TIME UNDER DIFFEREN-TIAL BINOCULAR ADAPTATION, by M. Conticelli and S. Fujiwara. [1964] [12]p. incl. diagrs. (AFOSR-64-2159) (AF EOAR-63-4) AD 451926 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 19: 177-188, Mar.-Apr. 1964.

Visuo-motor reaction time (RT) relative to a suprathreshold stimulus has been determined both in binocular and in monocular vision. Binocular RT is found to be slightly lower than monocular RT in the case where the two eyes are adapted to the same level. An enhancement of the difference between binocular and monocular RT is found in the case of differential binocular adaptation. It is as if the dark-adapted non-viewing eye would impair, from time to time, the perception mediated through the light-adapted viewing eye.

1199

Istituto Nazionale di Ottica, Florence (Italy).

NON-INDEPENDENCE OF RED AND BLUE ERG RESPONSES EVOKED BY INTERMITTENT STIMULA-TION, by A. M. Ercoles. [1964] [7]p. (Rept. no. 1061) (AFOSR-64-2480) (AF EOAR-63-4) AD 453821 Unclassified

Also published in Proc. Symposium on Physiology of Flicker; Second Symposium of the Internat'l. Soc. for Clinical Electroretinography, Sept. 1963, p. 522-528.

ERG responses have been recorded from the normal human eye using the following stimuli: a series of red pulses, one of blue pulses and a combined red-blue series. Stimulus frequency varied between 7.1 and 41.2 stim/sec. The essential finding is that the action exerted by a red stimulus upon the next blue one differs from that exerted by a blue stimulus upon the next red one: the response to red having a greater amplitude than the response to blue, in the combined red-blue series, while the red and blue responses have the same size in the homochromatic series. The red response in the combined red-blue series is larger than the red response in the homochromatic series, at least for frequencies under 11.0 stim/sec, while the blue response is larger in the combined sequence than in the homochromatic one, at least for frequencies over 11.0 stim/sec.

1200

Istituto Superiore di Sanità, Rome (Italy).

EFFECT OF DRUGS ON CENTRAL NERVOUS SYSTEM NEURONES, by V. C. Longo. Final technical rept. July 1, 1963, 16p. (AFOSR-5107) (AF 61(052)399) AD 414045 Unclassified

The present report exposes the results obtained during an investigation in the effects of drugs on the electrical activity of single cortical neurones. During the course of this investigation the following drugs were injected: eserine, scopolamine, amphetamine, tryptamine, and lysergic acid diethylamide (LSD). Although it is not possible with the present limited data to arrive at any clear-cut conclusion, some comments and indications in regard to future development of the research are the following: (1) In the sensorimotor cortex there seems to be some layers that have many cells responding with increased firing rate after application of external stimuli; (2) Both eserine and amphetamine provoke an increase in firing of single neurones; and (3) The "flattening of the EEG tracing provoked by tryptamin and LSD seems to be related, at least where it is concerned with the limbic cortex, with a diminution of cellular activity.

1201

Itek Corp., Waltham, Mass.

APPLICATION OF THE GALOIS CONNECTION TO IN-FORMATION SYSTEMS, by R. F. Barnes and R. W. Robinson. Final rept. Sept. 15, 1964 [31]p. incl. diagrs. table. (Rept. no. Itek 9078-1) (AFOSR-64-1868) (AF 49(638)1229) AD 607396 Unclassified

The authors' inquiry into the quantitative aspects of the concepts of similarity as applied to a simple variety of library systems led to the consideration of a large family of association schemes. Each scheme was uniquely determined by a particular transformation function--a map from the set of similarity coefficients for terms (or documents) to the set of similarity coefficients for documents (or terms). The transformations considered preserve the property of nonnegativity for sets of similarity coefficients, which allows one to show that there is a set of coefficients left fixed by any chosen transformation. This set of coefficients depends on the chosen transformation and represents exactly the degree of association demanded by consistency with the chosen transformation. Thus, for any transformation one arrives at a set of similarity coefficients which corresponds to it. An iterative method was advanced for the computation of the fixed set of similarity coefficients, and the particular analytic questions remaining center upon this method.

1202

Johns Hopkins U. Dept. of Biophysics, Baltimore, Md.

AN ISOLEUCINE ACCEPTOR sRNA FROM E. COLI
TRANSFERRING ISOLEUCINE INTO POLYPEPTIDE IN
RESPONSE TO POLYURIDYLIC ACID (Abstract), by
F. Gonano and G. von Ehrenstein. [1964] [1]p.
(AFOSR-65-0955) (AF 49(838)1304)   Unclassified

Presented at meeting of the Federation Amer. Soc.
Exper. Biol., Atlantic City, N. J., Apr. 9-14, 1964.

Also published in Federation Proc., v. 23: Mar.-Apr.
1964.

Two isoleucine acceptor sRNA's were obtained in about
equal amounts by a 300 transfer counter current dis-
tribution of E. coli B sRNA. Isoleucine was charged
to both of them by a purified isoleucine activating en-
zyme. Isoleucine bound to the first peak is incorporat-
ed into polypeptide in response to poly UA (5:1), where-
as isoleucine bound to the second peak is incorporated
in response to poly U and copolymers with a high
uridylic acid content. Three amino acids, phenylala-
nine, leucine and isoleucine have so far been found to
be incorporated in response to poly U. These apparent
coding ambiguities show that the requirements for cod-
ing for amino acids are less stringent in this system
than in natural protein synthesis.

1203

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

INFRARED SPECTRA OF $SiH_3C \equiv CH$ AND $SiD_3C \equiv CH$,
by R. B. Reeves, R. E. Wilde, and D. W.
Robinson. [1964] [7]p. incl. diagrs. tables, refs.
(AFOSR-84-1416) (AF 49(838)468) AD 444454
                                    Unclassified

Also published in Jour. Chem. Phys., v. 40: 125-131,
Jan. 1964.

Low-resolution infrared silylacetylene and silylace-
tylene-d3 enabled the fundamental vibrational fre-
quencies to be assigned to normal modes of motion.
Also, many of the overtone and combination bands
were tentatively assigned. Argon-matrix spectra at
4.2°K were helpful in assigning nearly degenerate vi-
brations, particularly the Si-C stretching motion.
Medium-resolution spectra enabled approximate values
to be obtained for the band origins and Coriolis coupling
constants of most of the perpendicular-type fundamen-
tals.

1204

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

RARE GAS ION REACTIONS WITH AMMONIA, by
G. R. Hertel and W. S. Koski. [1964] [3]p. (AFOSR-
84-1542) (AF 49(638)481) AD 446349   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 88:
1683-1685, May 5, 1984.

The fractional yields and the relative cross sections
for rare gas ion reactions with ammonia have been de-
termined for the 3 to 200 e.v. energy region. The re-
sults are in rough agreement with the Massey-Burhop
theory; however, anomalies are present. The implica-
tion of these results is discussed with respect to the
recently proposed mechanism for rare gas sensitization
for the production of hydrazine in the gas phase radiol-
ysis of ammonia.

1205

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

GAS PHASE REACTIONS BETWEEN CARBON TETRA-
CHLORIDE AND MASS ANALYZED IONS OF NITRO-
GEN BETWEEN 3 AND 200 E.V., by E. R. Weiner,
G. R. Hertel and W. S. Koski. [1964] [6]p. (AFOSR-
64-1543) (AF 49(838)481) AD 448123   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 788-
793, Mar. 5, 1984.

A tandem mass spectrometer has been constructed to
study ion-molecule and charge-transfer reactions. A
primary ion beam is generated and mass analyzed in the
first mass spectrometer. An ion lens system adjusts
the beam acceleration to a desired value between 3 and
200 v and focuses it into a reaction chamber containing
a target gas. Secondary ions formed in the reaction
chamber are extracted at right angles to the primary
beam, through an exit slit into the second mass spec-
trometer where they are mass analyzed. Z-Direction
deflection plates in the second spectrometer permit the
observation of secondary ions possessing momentum in
the direction of the primary ion beam. Thus, the re-
actions involving momentum transfer as well as charge
transfer may be studied.

1206

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

HOT ATOM CHEMISTRY, by W. S. Koski. Final rept.
Oct. 1983, 1v. (AFOSR-J1377) (AF 49(838)481)
AD 426571   Unclassified

The contents of this report are: Rare gas ion reactions
with ammonia; Gas phase reactions between carbon
tetrachloride and mass analyzed ions of N between 3
and 200 ev; and Positive bromine ion bombardment of
solid butane and benzene.

1207

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

CROSS SECTIONS FOR THE SINGLE CHARGE TRANS-
FER OF DOUBLE-CHARGED RARE-GAS IONS IN
THEIR OWN GASES, by G. R. Hertel and W. S. Koski.
[1984] [2]p. (AFOSR-65-0235) (AF 49(638)1301)
AD 811614   Unclassified

Also published in Jour. Chem. Phys., v. 40: 3452-3453, June 1, 1964.

In the case of doubly charged ions passing through their own gases at relatively low energies, cross-section measurements of single-electron transfers require experimental techniques which differentiate between the single charge transfers and the resonant double exchanges.

1208

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

ARGON-DEUTERIUM HYDRIDE ION REACTION, by M. A. Berta and W. S. Koski. [1964] [4]p. (AFOSR-65-0236) (AF 49(638)1301) AD 611915   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5098-5101, 1964.

Reactions of HD^+ with argon have been studied using a tandem mass spectrometer. In the first two reactions, attention was centered on the isotope effect, and the ratio ARH^+/ARD^+ between 2 and 25 ev varied from 1.3 to 1.9, respectively. In the charge transfer reaction, the cross section was measured from 2 to 70 ev, and indications were obtained that the reacting HD^+ ions were in vibrationally excited states.

1209

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

CROSS SECTIONS FOR SOME GAS-PHASE SINGLE-CHARGE-TRANSFER REACTIONS OF N_2^{++} AND Ar^{++}, by E. R. Weiner, G. R. Hertel, and W. S. Koski. [1963] [2]p. (AFOSR-65-0372) (AF 49(638)1301) AD 611739   Unclassified

Also published in Jour. Chem. Phys., v. 39: 3538-3539, Dec. 15, 1963.

Results are summarized of measurements of the charge transfer cross sections for a single-electron transfer to a doubly charged ion for the reactions $N_2^{++} + N_2 = N_2^+ + N_2^+$, $N_2^{++} + H_2O = N_2^+ + H_2O^+$, and $Ar^{++} + Ar = Ar^+ + Ar^+$.

1210

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

INFRARED SPECTRUM OF METHYLSILYL-D_3-ACETYLENE, by R. B. Reeves and D. W. Robinson. [1964] [3]p. (AFOSR-64-2430) (AF 49(638)1430) AD 453738   Unclassified

Also published in Jour. Chem. Phys., v. 41: 1699-1701, Sept. 15, 1964.

The near- and far-infrared spectra are reported for the molecule $D_3SiCCCH_3$ and the far-infrared spectrum

for $H_3SiCCCH_3$ supplementing earlier work. All of the infrared-active vibrations have been found and assigned to normal modes. The Q branches of most of the perpendicular bands have been resolved and rotationally assigned. Coriolis coupling constants have been calculated.

1211

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

SPECTRA OF MATRIX-ISOLATED WATER IN THE "PURE ROTATION" REGION, by D. W. Robinson. [1963] [3]p. incl. diagr. table, refs. (AFOSR-64-1507) (AF AFOSR-63-93) AD 446124   Unclassified

Also published in Jour. Chem. Phys., v. 39: 3430-3432, Dec. 1963.

The infrared spectra of matrix-isolated water in neon, argon, krypton, and xenon solids near 4°K have been obtained between 29 and 60 cm^{-1}. The few lines that are observed depend strongly on the matrix material and are in good agreement with lines in the v_1 and v_2 vibrational bands. This observation confirms the widely held belief that the fine structure in the near-infrared spectrum has a rotational or hindered-rotational origin. (Contractor's abstract)

1212

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

GEODESIC PARALLEL COORDINATES IN THE LARGE, by P. Hartman. [1964] [23]p. incl. diagr. refs. (AFOSR-65-1796) (AF AFOSR-62-45) AD 626485
                                    Unclassified

Also published in Amer. Jour. Math., v. 86: 705-727, Oct. 1964.

Let M be a 2-dimensional manifold with a Riemannian metric, C a jordan curve on M, $\gamma(r)$ the set of points on M a distance r from C, and $L(r)$ the length of the curve $\gamma(r)$. It is first noted that even in the euclidean plane with C a C^∞ curve, the function $L(r)$ need not be continuous. However, under very mild differentiability conditions, $L(r)$ is shown defined and well behaved outside of at most a closed set of r-values of Lebesque measure zero. Various inequalities used formerly by Fiala and Ahlfors are shown valid, even taking into account the exceptional set and the possible discontinuities of L. Several results are given on isoperimetric inequalities and related equations.

1213

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

TURBULENT SHEAR FLOW. Final rept. July 1, 1957 - Dec. 31, 1962. May 1963, 7p. (AFOSR-5323) (AF 49(638)248) AD 413904   Unclassified

The initial problems were the effect of rotation (about

the symmetry axis) on a round turbulent jet, and the effect of "sweep back" on a slot jet. The former was pursued with reasonable success; the latter proved too difficult a configuration to realize with precision. Therefore the normal exit case was pursued in some detail. The radial turbulent jet was also studied. These may be the first measurements made in such a configuration. Finally, in order to permit a more basic study, it was attempted to generate a nearly homogeneous turbulent shear flow. The technique is to introduce a non-uniform grid into a wind-tunnel test section. Preliminary work gave a fairly good, linear mean velocity profile, but the turbulence is still far from homogeneous.

1214

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

TWO TURBULENT SHEAR FLOWS. I. A PLANE JET. II. A RADIAL JET, by G. Heskestad. June 1963, 202p. (AF 49(638)248) AD 605595   Unclassified

Results from hot-wire measurements in a plane turbulent jet and a radial turbulent jet are reported. The plane jet was found to be approximately self-preserving sufficiently far downstream, where measurements of the intermittency and data for calculating the energy balance of the turbulent motion were made. Measurements were also made of the Reynolds number effect on the centerline development of the turbulent intensity and the flatness factor of the velocity derivative at a fixed downstream centerline-location. The radial jet was observed not to attain the degree of self-preservation noted for the plane jet in the range of the measurements. The mean velocity profiles were quite similar, but the meansquare turbulent velocity profiles were similar only away from the centerline, and the lateral intermittency distributions were highly dissimilar. Data for the energy balance was obtained at a convenient downstream location.

1215

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

CONCEPT OF FIELD MODES IN FLUID MECHANICS, by C. Kaplan. Apr. 1964, 58p. (AFOSR-64-0719) (AF 49(683)496) AD 600964   Unclassified

A new and novel method for studying the behavior of magnetohydrodynamic fields has been used to explore steady incompressible two-dimensional linearized fluid flow with finite viscosity. This method, based on the central idea of splitting the behavior of a flow field into independent modes of behavior, is then applied to the often-treated and well-known case of viscous incompressible flow over a semi-infinite flat plate immersed in an unbounded uniform stream.

1216

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

ANALOG COMPUTER RESEARCH INTO THE ENERGY

EXCHANGE BETWEEN GASES AND SOLIDS, by M. Rogers. May 1964, 222p. incl. diagrs. refs. (AFOSR-64-1001) (AF 49(638)496) AD 605159
Unclassified

A comparison is made between various models of the interaction. A description is given of the circuitry and techniques used to investigate the problem of energy exchange between gases and solids. Bounds on the applicability and interpretation of data obtained solely from computational experiments, whether performed with an analog or a digital computer, are delineated in some detail. Data are presented which was obtained in a series of analog computer experiments in gas surface interactions using several variations of a very simple model of the interaction potential, the lattice, and the physical state of the solid, particularly temperature. For the majority of the research, a non-linear coupling (potential) was used between gas particles and surface atom. Several major approximations were made in the formulation of the models investigated.

1217

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

A GENERALIZED LARGE DEFORMATION BEHAVIOUR FOR FACE-CENTERED CUBIC SOLIDS - HIGH PURITY COPPER, by J. F. Bell. [1964] [20]p. incl. diagrs. tables, refs. (AFOSR-65-1739) (AF 49(638)-1067) AD 625968   Unclassified

Also published in Philos. Mag., v. 10: 107-126, July 1964.

The stage III deformation of high purity copper single crystals of initially single slip orientations is found, through the Taylor aggregate theory, to be in close qualitative and quantitative agreement with Bell's generalized, temperature-dependent, dead annealed face-centered cubic polycrystalline stress-strain law. Parabolic stage III deformation is shown to be determinable from stage II measurement for all orientations. Thus, in dead annealed face-centered cubic polycrystals the wave speeds and strain of large amplitude plastic compression waves are governed by a constitutive relation whose origin is in the stage III deformation of face-centered cubic single crystals. The 49 high purity copper single crystal tension tests examined are found to have the same stage III parabola in the data of the several investigators. The stage III deformation, whose parabola coefficient is dependent upon the temperature of the test and the melting poing of the metal, is shown to be independent of the length of stage I and stage II deformation. (Contractor's abstract)

1218

Johsn Hopkins U. [Dept. of Physics] Baltimore, Md.

THE SPECTRA OF THE DOUBLY AND TRIPLY IONIZED RARE EARTHS, by G. H. Dieke and H. M. Crosswhite. [1963] [12]p. incl. illus. diagrs. tables, refs. (AFOSR-J908) (AF AFOSR-63-104) AD 415882
Unclassified

Also published in Appl. Opt., v. 2: 675-686, July 1963.

The present status of our knowledge of the structure of the spectra of the doubly and triply ionized spectra of the rare earths is derived partly from experimental data of the emission spectra of the free ions which provide the energy level scheme in great detail but are difficult and laborious to analyze. For the lower levels knowledge of the structure comes from the crystal absorption and fluorescence spectra. In all cases approximate theoretical calculations of the energies are essential. (Contractor's abstract)

1219

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

SPECTROSCOPIC INSTRUMENTATION FROM THE USER'S POINT OF VIEW, by G. H. Dieke and D. F. Heath. 1964, 4p. (AFOSR-65-0446) (AF AFOSR-63-104) AD 612639　　Unclassified

Presented at Conf. on Photographic and Spectroscopic Optics, Internat'l. Commission for Optics, Tokyo and Kyoto (Japan), Sept. 1-8, 1964.

Experimentation with a 5-meter vacuum Ebert Fastie spectrograph is reported; the experimentation was into very high resolution, particularly in the vacuum ultraviolet. Orders were separated by an order sorter with cross dispersion: above 2000A a quartz prism was used and below, a grating with a concave mirror. Both order sorters performed adequately. A 600,000 resolving power was achieved. The spectrograph apparently will give in the vacuum UV above 1000A a resolution and wave number accuracy obtainable only for the visible and adjacent regions. Except for very special light sources, resolution and wave number accuracy are determined by actual line width rather than by performance of the spectrograph.

1220

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE SPECTRA OF DOUBLY AND TRIPLY IONIZED RARE EARTHS, by G. H. Dieke. Final rept. Dec. 31, 1964, 5p. incl. diagr. refs. (AFOSR-65-0576) (AF AFOSR-63-104)　　Unclassified

Energy levels of the 4 lowest configurations of the doubly, i.e. praseodymium, gadolinium, holmium, and ytterbium, and triply, i.e. praseodymium, neodymium, and erbium, ionized rare earth atoms were obtained from the vapor emission spectra of these elements. Previous work has been chiefly concentrated on the doubly ionized atoms, as the important parts of the spectra of the triply ionized atoms lie in the vacuum ultraviolet below 2000A. The chief purpose in obtaining the energy levels of the free ions is to compare them with the energy levels of the same ions obtained from crystal spectra and thus have a direct evaluation of the influence of the solid state forces.

1221

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

MESON RESONANCE PRODUCTION IN π^+-d INTERACTIONS AT 1.23 BEV/C, by R. Kraemer, L. Madansky and others. [1964] [11]p. incl. diagrs. refs. (AFOSR-65-0139) (AF AFOSR-63-234) AD 455935　　Unclassified

Also published in Phys. Rev., v. 136: B496-B506, Oct. 26, 1964.

A report is made of the study of production and decay properties of the η^0, ω^0, ρ^0, and π^0 mesons produced in π^+-d collisions at 1.23 bev/c in the Berkeley 72-in bubble chamber. The production processes are analyzed in terms of π^+-neutron interactions through the use of an impulse model. A clear enhancement due to the $N_{1/2}$ (1688) resonance is observed in the π^0 (charge exchange) production cross section. The mass of the η^0 meson is found to be $m_{\eta 0} = 552 \pm 3$ mev with a branching ratio of $(\eta^0 \to$ all neutrals$)/(\eta^0 \to \pi^+ \pi^- \pi^0) = 3.6 \pm 0.8$, and the partial width $\Gamma(N_{1/2*}$ (1688) $\to p + \eta^0) < 2$ mev. The central value of the ω^0-meson peak is found to be $m_{\omega 0} = 781 \pm 2$ mev), with a branching ratio $(\omega^0 \to$ all neutrals$)/(\omega^0 \to \pi^+ \pi^- \pi^0) = 8 \pm 3\%$, and an upper limit of 5% for decay into 2 charged pions. The production of the ω^0 is found to be inconsistent with the single-vector-meson exchange model. (Contractor's abstract)

1222

Johns Hopkins U. Dept. of Physiology, Baltimore, Md.

THE RELATION OF THALAMIC CELL RESPONSE TO PERIPHERAL STIMULI VARIED OVER AN INTENSIVE CONTINUUM, by V. B. Mountcastle, G. F. Poggio, and G. Werner. [1963] [28]p. incl. diagrs. tables, refs. (AFOSR-64-1079) (AF AFOSR-62-31) AD 441478　　Unclassified

Also published in Jour. Neurophysiol., v. 26: 807-834, Sept. 1963.

Those cells of the ventrobasal nuclear complex of the thalamus which are responsive to the steady position and to movements of the joints have been studied by the method of single unit analysis, in unanesthetized, deafferented-head monkeys. These cells, their related peripheral afferents, and their intervening second-order cells form a system which functions to detect the angular positions of the joints, and which details by its thalamocortical discharge pattern and frequencies the direction and rate of movement, and the steady positions of the limbs. The independent variable, joint angle, has been controlled with an instrument allowing independent variation of the speed of rotation and the extent of the angle turned, and scaled along true ratio scales. The zeros of these scales are set by the threshold, or edge of the excitatory angle, for

each cell studied. Thalamic cell discharges were
measured in terms of impulses per unit time, and the
validity of measurement established.

1223

Johns Hopkins U. Dept. of Physiology, Baltimore, Md.

THE VARIABILITY OF CENTRAL NEURAL ACTIVITY
IN A SENSORY SYSTEM, AND ITS IMPLICATIONS FOR
THE CENTRAL REFLECTION OF SENSORY EVENTS,
by G. Werner and V. B. Mountcastie. [1963] [20]p.
incl. diagrs. refs. (AFOSR-64-1080) (AF AFOSR-62-
31) AD 441480   Unclassified

Also published in Jour. Neurophysiol., v. 26: 958-
977, Nov. 1963.

The time intervals between consecutive discharges of
single ventrobasal thalamic neurons, both when active
in the absence of intentional peripheral stimuli and
when driven by steady sensory stimulation, were meas-
ured in unanesthetized mecaque monkeys. Some sta-
tistical parameters of these interval sequences were
estimated, with the hope of determining which quanti-
tative aspects of neural impulse trains may be of im-
portance for the central neural representation of sen-
sory events, and for discrimination. The standard
deviation is a constant percentage of the mean interval
for populations of discharge intervals during that ac-
tivity of thalamic neurons evoked by steady peripheral
stimuli.

1224

Johns Hopkins U. Dept. of Physiology, Baltimore, Md.

THE FUNCTIONAL PROPERTIES OF VENTROBASAL
THALAMIC NEURONS STUDIED IN UNANESTHETIZED
MONKEYS, by G. F. Poggio and V. B. Mountcastie.
[1963] [32]p. incl. illus. diagrs. tables, refs.
(AFOSR-64-1081) (AF AFOSR-62-31) AD 441470
                                        Unclassified

Also published in Jour. Neurophysiol., v. 26: 775-
806, Sept. 1963.

The method of single unit analysis has been used to
study the functional properties of the third-order
neurons of the lemniscai component of the somatic af-
ferent system. These cells compose the ventrobasal
nuclear complex, the thalamic relay nucleus of the
system. The experiments were made on unanesthetized
monkeys whose heads were made free of pain by an in-
tracranial retrogasserian neurectomy, and by transec-
tion of the ascending branches of the cervical plexus.
Those functional properties of thalamic cells which we
define as static were studied in these unanesthetized
animals. The properties of the mode of the adequate
exciting peripheral stimulus and the locus of the peri-
pheral field have been determined for nearly 1,000
thalamic neurons, 98% of which was later shown by
the reconstruction of serial sections to be located with-
in the cytoarchitectural confines of the ventrobasal
nuclear complex.

1225

Johns Hopkins U. [Dept. of Physiology] Baltimore, Md.

FUNCTIONAL PROPERTIES OF NEURONS IN THE
LATERAL CERVICAL NUCLEUS OF THE CAT, by E.
Oswaldo-Cruz and C. Kidd. [1964] [14]p. (AFOSR-64-
1083) (AF AFOSR-62-31) AD 441489   Unclassified

Also published in Jour. Neurophysiol., v. 27: 1-14,
1964.

A study was made of the functional properties of cells in
the lateral cervical nucleus in lightly anesthetized cats.
The large majority was activated by natural stimulation
of the skin by either gentle movement of hairs or by
slight mechanical displacement of the skin. They were
related to small, continuous, precisely delineated re-
ceptive fields on the ipsilateral body surface; these
fields were never observed to change in size or position
while a given cell was under observation. Surround or
lateral inhibition was never observed. No single cell
was found which could be made to vary the rate of its
discharge by gentle rotation of a joint. The methods
used did not reveal a topographic representation of
the body surface within the nucleus. Cells of the nu-
cleus respond to brief electrical stimuli applied to their
cutaneous receptive fields with a brief burst of im-
pulses. The latency and number of impulses in this
burst are a function of the intensity and frequency of the
stimulus, and of its position within the receptive field.
These studies suggest that synaptic transmission in the
nucleus occurs with a considerable safety factor.

1226

Johns Hopkins U. [Dept. of Physiology] Baltimore, Md.

[SINGLE UNIT STUDIES OF CORTICAL AND SUBCOR-
TICAL FUNCTION IN UNRESTRAINED ANIMALS].
Final technical rept. 1963, 8p. (AFOSR-64-1435)
(AF AFOSR-62-31) AD 604469   Unclassified

A preparation was devised which allowed study of the
central nervous system of primates in the unanesthe-
tized state, without provocation of pain, using the meth-
od of single unit analysis. Studies were made of the
neurons of the ventrobasal nuclear complex, the thala-
mocortical input stage of the somatic afferent sys-
tem. The highly specific nature of the lemniscai sys-
tem in terms of place and quality were found to be as
certain and precise in the waking animal as they had
previously been found to be in the anesthetized one.
The temporal capacity of the lemniscai system was
found to be greater in the former state than the later by
an entire order of magnitude. A quantitative study was
made of the relation between thalamic cell response and
the driving peripheral stimulus, as the latter is varied
along an intensive continuum.

1227

Jonker Business Machines, Inc., Gaithersburg, Md.

A MODEL INFORMATION RETRIEVAL NETWORK FOR
GOVERNMENT, SCIENCE AND INDUSTRY. A PRO-
POSED BASIC CONFIGURATION FOR A NATIONAL
SYSTEM OF INTERLINKING INFORMATION RETRIEV-

AL NETWORKS. May 1964, 259p. (AFOSR-64-0942)
(AF 49(638)1209) AD 600221   Unclassified

The report describes the technical, organizational and
financial aspects of a model Information Retrieval Net-
work which could be made operational at the present
time.

1228

Kansas State U. [Dept. of Chemical Engineering] Manhattan.

HEAT TRANSFER TO MAGNETOHYDRODYNAMIC FLOW IN A FLAT DUCT, by L. E. Erickson, C. S. Wang and others [1964] [11]p. incl. diagrs. table, refs. (AFOSR-64-2254) (AF AFOSR-64-463)
AD 452359   Unclassified

Also published in Jour. Appl. Math. and Phys. (ZAMP), v. 15: 408-418, 1964.

The case with the constant wall temperature and with viscous and electrical dissipation, which is considered in this paper was previously investigated by Nigam and Singh. However, the Joule's heating term in their paper was wrongly represented, rendering their results invalid. The purpose of this paper is to present the results of the exact solution of the same problem with the use of a finite difference analysis. The fluid properties are assumed to be constant. A magnetic field is imposed perpendicularly to the duct walls, and there is a net electrical current flow parallel to the walls and perpendicular to the flow direction with a variable external resistance connecting the two end plates. The velocity profile is the fully developed Hartmann profile The temperature profile is uniform at the beginning of the thermal entrance region which is under consideration. Viscous and electrical dissipation effects are not neglected.

1229

Kansas State U. [Dept. of Chemical Engineering] Manhattan.

CONVECTIVE MODEL OF HARTMANN FLOW, by L. T. Fan, C. L. Hwang, and W. S. Hwang. [1964] [2]p. incl. diagr. (AFOSR-65-0564) (AF AFOSR-64-463)
AD 615183   Unclassified

Also published in AIAA Jour., v. 2: 1859-1860, Oct. 1964.

An analysis of the residence time distribution of a tracer in the fluid flowing through a continuous flow system is one of the important tools in the study of dynamic and dispersion characteristics of the system. In this note the residence time distribution of steady magnetic flow in a parallel plate channel with a uniform transverse magnetic field, called the Hartmann flow, is analyzed. The residence time distribution function for Hartmann flow is developed.

1230

Kansas State U. Dept. of Physics, Manhattan.

THE CRYSTALLOGRAPHY OF SOLID NITROGEN OXIDES. SODIUM HYPONITRITE—POTASSIUM NITRITE, by R. D. Dragsdorf, S. C. Chang, and R. L. Hollis Final rept. Aug. 3, 1964, 94p. incl. illus. diagrs. tables, refs. (AFOSR-64-1469) (AF AFOSR-61-24) AD 604476   Unclassified

The purpose of the research was to study the crystal structure of sodium hyponitrite and potassium nitrite by the x-ray diffraction method. Three forms of sodium hyponitrite, i.e., anhydrous, octa, and pentahydrate, were obtained. Rotation and zero-level Weissenberg photographs were obtained and analyzed. Patterson projection, Patterson function, Harker section, and electron density contour maps were calculated. The crystal structure of potassium nitrite was redetermined. The cell dimensions were refined by improving the experimental techniques and employing the method of the least squares to minimize error. Instead of a monoclinic unit cell as reported, a rhombohedral cell seems most probable for the KNO_2 crystal. The molecule is planar. A phase transformation was found at -17.7°C. The thermal properties near the transition were measured.

1231

Kansas State U. [Dept. of Psychology] Manhattan.

A VERSATILE ELECTRONIC TRACKING APPARATUS (VETA), by D. Trumbo, R. Eslinger and others. [1963] [8]p. (AFOSR-J674) (AF AFOSR-62-17) AD 413463
                                          Unclassified

Also published in Perceptual and Motor Skills, v. 16: 649-656, 1963.

An electronic tracking and scoring system which gives access to relatively complete response data is described. Input, output, error and acceleration data are recorded on magnetic tape and may either be read out for visual inspection or read directly into analog computers and correlators for further analysis. An important feature of the system is that it readily permits the programming of various complex wave form inputs of either regular or irregular patterns in sequences of any length. Type or pattern of input may be varied between trials. The system is highly automated and easily calibrated.

1232

Kansas U. Dept. of Chemistry, Lawrence.

EXPERIMENTAL EVALUATION OF LIQUID-JUNCTION POTENTIAL, by I. V. Nelson and R. T. Iwamoto. [1963] [5]p. incl. diagr. tables, refs. (AFOSR-J635) (AF AFOSR-61-8) AD 414920   Unclassified

Also published in Anal. Chem., v. 37: 867-871, June 1963.

The feasibility of using the half-wave potential of the ferrocene, ferricinium ion; benzylferrocene, benzyl-ferriciniumion; tris(4,7-dimethyl-1,10-phenanthroline)-iron(II), tris(4,7-dimethyl-1,10-phenanthroline)iron(III), and bis(2,9-dimethyl-1,10-phenanthroline)copper(I), bis(2,9-dimethyl-1,10-phenanthroline)copper(II) couples for the evaluation of liquid-junction potential has been investigated. Of the four redox systems studied, the 4,7-DMPhFe(II), 4,7-DMPhFe(III) couple is the best, particularly for evaluating changes in liquid-junction potential in voltammetric studies. (Contractor's abstract)

1233

Kansas U. [Dept. of Chemistry] Lawrence.

MECHANISM OF INORGANIC REACTIONS: BRIDGE
MECHANISM IN ELECTROCHEMICAL OXIDATION
AND REDUCTION OF METAL IONS, by R. T. Iwamoto.
Final rept. Oct. 1, 1961-Dec. 31, 1962. Nov. 11,
1963, 3p. (AFOSR-J1367) (AF AFOSR-61-8)
AD 426575   Unclassified

To obtain information fundamental to understanding
the mechanism of inorganic oxidation-reduction reac-
tions, in particular of those involving a bridged acti-
vated complex, use of nonaqueous solvents and of an
electrode was proposed. An investigation of various
carboxylic acids as electron mediators in inorganic
electrochemical oxidation-reduction reactions was
begun. A reaction between Cu(II) ion and Cu metal in
acetic acid was uncovered. A study of the polarographic
behavior of Ni(II) in acetonitrile in the presence of
chloride was made to obtain information on how the
coordination sphere around an ion influences behavior
of the ion in solution. One of the important problems
in the studies on the nature and behavior of inorganic
ions in nonaqueous media is the effect of residual
water. Formation constants of aquo-copper(II) com-
plexes is acetone were investigated and prepared for
publication. (Contractor's abstract, modified)

1234

Kansas U. Dept. of Chemistry, Lawrence.

VOLTAMMETRY AND ELECTRON PARAMAGNETIC
RESONANCE SPECTRA OF HALONITROBENZENE
ANION RADICALS, by T. Kitagawa, T. P. Layloff,
and R. N. Adams. [1963] [2]p. incl. table. (AFOSR-
65-0524) (AF AFOSR-62-14) AD 614291
                                       Unclassified

Also published in Anal. Chem., v. 35: 1086-1087,
July 1963.

Electron paramagnetic resonance (EPR) spectra of
halonitrobenzene anion radicals was studied, using
unsubstituted nitrobenzene for comparison. The re-
sults are summarized in a table. Halonitrobenzenes
were reduced using dimethylformamide containing
0.1M tetraethylammonium perchlorate as supporting
electrolyte. It was found that all 3 iodonitrobenzenes
lose their iodine, all 3 chloronitrobenzenes retain
their chlorine, only the orthobromonitrobenzene loses
the bromine, and only the ortho-fluoronitrobenzene
retains the flourine.

1235

Kansas U. Dept. of Chemistry, Lawrence.

CORRELATION OF SOLVENT EFFECTS ON ELEC-
TRON PARAMAGNETIC RESONANCE SPECTRA OF
THE NITROBENZENE ANION RADICAL, by J. Q.
Chambers, III, T. P. Layloff, and R. N. Adams. [1964]
[2]p. incl. diagrs. (AFOSR-65-0525) (AF AFOSR-62-
14) AD 613924   Unclassified

Also published in Jour. Phys. Chem., v. 68: 661-662,
Mar. 1964.

The electron paramagnetic resonance spectrum of the
nitrobenzene anion radical was obtained by electrolysis
in dimethylformamide(DMF)-water mixtures using tetra-
ethylammonium perchlorate as the supporting electro-
lyte. The spectra were obtained with slow magnetic
field sweeps so that proton coupling constants could be
evaluated accurately. There exists a 1:1 correlation
between the N^{14} coupling constant (a_N) and the doublet
splitting of the para hydrogen $a_{H(d, p)}$. Thus, for every
a_N there is a unique $a_{H(d, p)}$. This relationship between
a_N and $a_{H(d, p)}$ for DMF-H_2O mixtures includes all
solvent systems studies to date with the exception of
Ward's spectrum in tetrahydrofuran.

1236

Kansas U. Dept. of Chemistry, Lawrence.

EFFECT OF METAL IONS ON NUCLEAR HYPERFINE
COUPLING CONSTANTS IN EPR SPECTRA, by T.
Kitagawa, T. P. Layloff, and R. N. Adams. [1964] [2]p.
incl. diagr. (AFOSR-65-0526) (AF AFOSR-62-14)
AD 613856   Unclassified

Also published in Anal. Chem., v. 36: 935-926, Apr.
1964.

The effects of metal ions on the nuclear hyperfine
coupling constants of the electron paramagnetic reso-
nance (EPR) spectra of a variety of anions of aromatic
nitro compounds were investigated. The anion radical
of p-chloronitrobenzene was selected as a model system
since its EPR spectrum consists of 3 well resolved
triplets resulting from interaction of the unpaired elec-
tron with the N^{14} nucleus, 2 equivalent (ortho) protons
and 2 more equivalent (meta) protons. The radical
anions were generated electrochemically in dimethyl-
formamide (DMF) containing the metal ions to be in-
vestigated as supporting electrolytes. The effect of
the metal ion on the N^{14} coupling constant (a_N) was
investigated.

1237

Kansas U. Dept. of Chemistry, Lawrence.

OPERATIONAL AMPLIFIER CIRCUITS FOR CON-
TROLLED POTENTIAL CYCLIC VOLTAMMETRY II,
by J. R. Alden, J. Q. Chambers, and R. N. Adams.
[1963] [6]p. incl. diagrs. (AFOSR-65-0527)
(AF AFOSR-62-14) AD 614195   Unclassified

Also published in Jour. Electroanal. Chem., v. 5:
152-157, 1963.

Several practical, inexpensive, operational amplifier
(OA) circuits are described which are particularly use-
ful in single sweep and cyclic voltammetry at stationary
electrodes. Specific adaptations of OA's to electro-
analytical instrumentation were made some time ago by
Booman and coworkers and DeFord among others.
Highly finished polarographic instruments have been

desig1ed by Kelly and coworkers. The instruments described herein are functional, devoid of multi-purpose appendages, and specifically oriented towards solid elsctrode applications. Their reliability has been proven by continuous operation fcr several yr in a variety of modern electroanalytical operations. The units function satisfactorily with aqueous or nonaqueous electrochemical systems. The instruments consist of ti.e basic OA potentiostat coupled with a cyclic voltage scanning input. Two forms of cyclic scanner are described, a mechanical or motor driven unit, and an OA integrator nstwork which is more versatile. Cyclic voltammetry appears to have great utility, and, since any cyclic unit can be used for single sweep operation, no purpose is seen for building single sweep polarographs as such.

1238

Kansas U. Dept. of Chemistry, Lawrence.

TRIANGULAR WAVE CYCLIC VOLTAMMETRY. I, by Z. Galus, H. Y. Lee, and R. N. Adams. [1963] [6]p. incl. diagrs. refs. (AFOSR-65-0528) (AF AFOSR-62-14) AD 613737　Unclassified

Also published in Jour. Electroanal. Chem., v. 5: 17-22, 1963.

Cyclic voltammetry using moderately slow sweep rates, and hence pen and ink recording, is advantageous for examining the overall mechanisms of complex organic electrode processes. The method is particularly well suited to the study of organic oxidations at solid electrodes. When coupled with single sweep peak voltammetry for measuring charge transfer rates and other kinetic parameters, it can be a powerful tool for the study of organic electrode processes.

1239

Kansas U. Dept. of Chemistry, Lawrence.

APPLICATION OF ELECTRON PARAMAGNETIC RESONANCE TECHNIQUES IN ELECTROCHEMISTRY, by R. N. Adams. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0539) (AF AFOSR-62-14) AD 614538　Unclassified

Also published in Jour. Electroanal. Chem., v. 8: 151-162, 1963.

The roles of electrochemistry and elsctron paramagnetic resonance (EPR) are discussed, including the contributions of each technique to the problsms of the other. EPR has contributed to electrochemistry by (1) the detection and identification of radical intermediates in electrode reactions and (2) providing information about solution interactions of radical ions which contribute to a fuller understanding of these sntities as oxidation-reduction intermediates. Elsctrochemistry has contributed to EPR, especially in the generation of anion radicals, by offering wider range of experimental conditions than previously available.

1240

Kansas U. Dept. of Chemistry, Lawrence.

ISOTOPIC MOLECULES: SEPARATION BY RECYCLE GAS CHROMATOGRAPHY, by J. W. Root, E. K. C. Lee, and F. S. Rowland. Interim technical rept. 1962-1963. [Sept. 1963] [9]p. incl. diagrs. refs. (AFOSR-64-0024) (AF AFOSR-62-15) AD 429769　Unclassified

Also published in Science, v. 143: 676, 1964.

Gas chromatographic columns, greatly extended in length by the use of paired columns in a recycling apparatus, have been used to separate butane ($n\text{-}C_4H_{10}$) from deuterated butane ($n\text{-}C_4D_{10}$) and methane (CH_4) from deuterated methane (CD_4). The separation of monotritiated cyclobutane (C_4H_7T) from cyclobutane (C_4H_8) is nearly complete. This procedure is generally applicable to a wide variety of separations of isotopic molecules. (Contractor's abstract)

1241

Kansas U. Dept. of Chemistry, Lawrence.

POLAROGRAPHIC EVALUATION OF THE FORMATION CONSTANTS OF AQUO-COPPER(II) COMPLEXES IN ACETONE, by I. V. Nelson and R. T. Iwamoto. [1964] [3]p. incl. diagrs. tables. (AFOSR-64-1515) (AF AFOSR-63-220) AD 446370　Unclassified

Also published in Inorg. Chem., v. 3: 661-663, May 1964.

Formation constants for the four aquo-copper(II) complexes $Cu(H_2O)^{+2}$, $Cu(H_2O)_2^{+2}$, $Cu(H_2O)_3^{+2}$, and $Cu(H_2O)_4^{+2}$ in acetone have been evaluated. Log k values are 1.75, 1.50, 1.00, and 0.75 in 0.1 M LiClO$_4$ solution and 1.75, 1.25, 0.80, and 0.65 in 0.1 M $(C_2H_5)_4NClO_4$ solution. (Contractor's abstract)

1242

Kansas U. Dept. of Chemistry, Lawrence.

VOLTAMMETRIC EVALUATION OF THE STABILITY OF TRICHLORIDE, TRIBROMIDE, AND TRIIODIDE IONS IN NITROMETHANE, ACETONE, AND ACETONITRILE, by I. V. Nelson and R. T. Iwamoto. [1964] [4]p. incl. table, refs. (AFOSR-64-1516) (AF AFOSR-63-220) AD 446374　Unclassified

Also published in Jour. Electroanal. Chem., v. 7: 218-221, 1964.

The formation constants of trichloride, tribromide, and triiodide ions in acetonitrile and tribromide and triiodide ions in nitromethane and in acetone have bsen evaluated from electrochemical data. In addition, lower limits for ths formation constant of the trichloride ion in acstone and in nitromethane have bsen calculated.

The order of stability of the trihalides in these three aprotic solvents is $Cl_3^- > Br_3^- > I_3^-$, the reverse of that found in water. (Contractor's abstract)

1243

Kansas U. Dept. of Chemistry, Lawrence.

ELECTROCHEMICAL BEHAVIOR OF COPPER IONS AND SILVER ION IN HYDRACRYLONITRILE AND SOME RELATED NITRILES, by F. Farha, Jr. and R. T. Iwamoto. [1964] [10]p. incl. tables, refs. (AFOSR-64-2208) (AF AFOSR-63-220) AD 452390
Unclassified

Also published in Jour. Electroanal. Chem., v. 8: 55-64, 1964.

The electrochemical behavior of copper ions in hydracrylonitrile and related nitriles has been investigated. It is of interest to note that in hydracrylonitrile copper(II) ion is solvated by the nitrile group, whereas in I : I alcohol-nitrile mixtures, it is solvated by the hydroxyl group. This unusual situation appears to be due to the fact that hydracrylonitrile (dielectric constant, 65), I : I ethanol-acetonitrile mixture (dielectirc constant, 32), and I : I I-butanol—propionitrile mixture are polar solvent systems and, therefore, favor the more polar solvated form of copper(II) ion. This, in hydracrylonitrile has the solvent molecules oriented with the nitrile group attached to copper(II) ion and the hydroxyl group sticking out and forming a polar outer sheath and in I : I alcohol—nitrile mixture has alcohol rather than nitrile molecules in the coordination sphere. Nitrile-solvated copper(II) ion with an outer sheath consisting only of alkyl groups behaves like a non-polar solute. Except for the fact that silver(I) ion is reduced at potentials more positive than those at which copper (I) ion is reduced, the electrochemical reduction of silver(I) ion in hydracrylonitrile and related nitriles is similar to that of copper(I) ion. (Contractor's abstract)

1244

Kansas U. Dept. of Chemistry, Lawrence.

CONTRIBUTION OF INTERIONIC FORCES TO THE THERMAL CONDUCTIVITY OF DILUTE ELECTROLYTE SOLUTIONS, by R. J. Bearman. [1964] [2]p. (AFOSR-65-1131) (AF AFOSR-63-376) AD 619619
Unclassified

Also published in Jour. Chem. Phys., v. 41: 3924-3925, Dec. 15, 1964.

The contribution λ_{ion} of interionic forces to the thermal conductivity of dilute electrolyte solutions is calculated on the basis of the Debye-Hückel model. It is found to vary as x^3 or (concentration)$^{3/2}$ according to the expression $\lambda_{ion} = 1/3 \; x(e^2/\epsilon T)\Sigma_\beta z_\beta^2 c_\beta D_\beta$, where x is the inverse Debye length, e is the $\lambda_{ion} = 1/3 x(e^2/\epsilon T)\Sigma_\beta z_\beta^2 c_\beta D_\beta$, where x is the inverse Debye length, e is the electronic charge, ϵ is dielectric constant of solvent, z is charge number, c_β is concentra-

tion of dissolved ion β in units of number of ions per cubic centimeter, and D_β is the self-diffusion coefficient of the ion.

1245

Kansas U. [Dept. of Physics] Lawrence.

LIQUID NITROGEN/ARGON BUBBLE CHAMBER DESIGN PROJECT, by R. Stump. Final rept. [1963] 6p. incl. diagr. (AFOSR-4969) (AF AFOSR-61-86) AD 414166
Unclassified

This report discusses a project undertaken with the purpose of designing some equipment for research in high-energy physics, and of planning experiments to be done at the ZGS accelerator at the Argonne National Lab. Three lines of investigation were followed: the design of a bubble chamber suitable for use with liquid nitrogen or liquid argon; the design of a spark chamber for some specific experiments; and the detailed investigation of several experiments.

1246

Karolinska Inst., Stockholm (Sweden).

SYMPATHETIC VASODILATOR OUTFLOW, by B. Uvnas. Final technical rept. Mar. 29, 1963 [11]p. incl. illus. diagrs. refs. (AFOSR-4849) (AF 61(052)-502) AD 413763
Unclassified

Excitation of the sympathetic vasodilator outflow by hypothalamic and medullary stimulation causes a concomitant increase of cardiac contractile force and of skeletal muscle blood flow indicating those effects being integral parts of the reaction pattern elicited by intracerebral activation of the sympathetic vasodilator system. Vasodilatation due to excitation of cholinergic vasodilator nerves produced a decrease in peripheral resistance amounting to about 70% of the decrease caused by metabolic vasodilatation. It is considered that vasodilator nerve activity produces an arteriolar dilatation whereas vasodilatation due to inhibition of vasoconstrictor nerve activity or following muscular contraction induces relaxation of smooth muscles in both arterioles and precapillary sphincters.

1247

Karolinska Inst., Stockholm (Sweden).

SYMPATHETIC VASODILATOR OUTFLOW, by B. Uvnas. Final rept. Nov. 13, 1963 [6]p. incl. diagrs. table. (AFOSR-65-1529) (AF EOAR-64-27) AD 623792
Unclassified

Under this investigation, sympathetic vasodilator nerves to the skeletal muscles in dogs were activated by: (1) Electrical hypothalamic stimulation in anesthetized dogs; (2) Electrical hypothalamus stimulation in unanesthetized dogs by chronically implanted electrodes; and (3) External stimuli (firing shot) to unanesthetized dogs. Activation of sympathetic vasodilator nerves seems to be associated with a behavior reaction pattern that could be interpreted as due to fear. The occurrence of

sympathetic vasodilator fibers to the skeletal muscles of various species was also investigated. Vasodilator fibers were found in the 5 different species of beasts studied, but not in 7 species of apes and lemurs investigated. The observation has a bearing on the undissolved question concerning the existence of sympathetic vasodilator fibers to the skeletal muscles in man. (Contractor's abstract)

1248

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

QUANTITATIVE STUDIES ON PIGMENT MIGRATION AND LIGHT SENSITIVITY IN THE COMPOUND EYE AT DIFFERENT LIGHT INTENSITIES, by C. G. Bernhard and D. Ottoson. [1964] [14]p. (AFOSR-64-1699) (AF 61(052)21) AD 448274   Unclassified

Also published in Jour. Gen. Physiol., v. 47: 465-478, Jan. 1964.

Comparative electrophysiological and histological studies were made on the functional significance of the secondary iris pigment migration for the sensitivity of the eye in the noctuid moth Cerapteryx graminis. The pigment position at different adapting light intensities was studied as well as the influence of different positions on the sensitivity of the eye. Adapting light intensities above a certain value hold the pigment in light position. At a 3 log units lower intensity the pigment is brought into dark position and at light intensities between these limiting values the pigment attains intermediate positions. The results indicate that at light intensities between the limiting values the pigment shifts closely follow the changes in intensity of the environmental light.

1249

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

STUDIES ON THE ULTRASTRUCTURE OF DENTAL ENAMEL. IV. THE MINERALIZATION OF NORMAL HUMAN ENAMEL, by B. Angmar, D. Carlstrom, and J. E. Glas. [1961] [12]p. (AFOSR-J350) (AF 61(052)-386) AD 408006   Unclassified

Also published in Jour. Ultrastruct. Research, v. 8: 12-23, 1963.

The mineralization pattern of normal permanent enamel of ten human incisors was studied with quantitative contact microradiography. A detailed description of the technique is given. The general trend in the mineralization pattern consisted in a smooth decrease in the amount of mineral salts from the surface of the enamel toward the dentinenamel junction. This decrease varied considerably in individual samples, the extreme values being 0.7 and 4.4% mineral salts by weight. A simultaneous investigation with polarized light microscopy revealed no correlation between the birefringence and the mineral content. Permanent enamel was found to be nonimbibable with immersion

liquids other than water. The influence of the hydration state of enamel on the polarized light picture is also discussed in detail.

1250

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

STUDIES ON THE ULTRASTRUCTURE OF DENTAL ENAMEL. V. THE STATE OF WATER IN HUMAN ENAMEL, by D. Carlstrom, J. E. Glas, and B. Angmar. [1963] [6]p. (AFOSR-J351) (AF 61(052)386) AD 408005   Unclassified

Also published in Jour. Ultrastruct. Research, v. 8: 24-29, 1963.

The changes in birefringence of normal enamel upon heating could be interpreted as being caused by loss of water. The water in enamel was found to be bound in two different ways. A small part, which is very loosely bound, is probably related to the organic matrix whereas the greater part is firmly bound to the mineral phase.

1251

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

ULTRASTRUCTURE OF BIOLOGICAL CALCIFICATIONS, by D. Carlstrom. Final technical rept. Oct. 31, 1963, 8p. (AFOSR-J1320) (AF EOAR-62-11) AD 424237   Unclassified

The optical properties of normal and carious dental enamel were related to its ultrastructural organization. A crystallographic investigation of otoliths from 58 vertebrate species showed that these calcified bodies could consist of 5 different minerals. The binding mode of carbonate in mineral and biological apatites has been investigated by physical methods. A new structure for carbonate apatites is proposed.

1252

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

A CRYSTALLOGRAPHIC STUDY OF VERTEBRATE OTOLITHS, by D. Carlstrom. [1963] [23]p. (AFOSR-64-1175) (AF EOAR-62-11) AD 442991 Unclassified

Also published in Biol. Bull. 125: 441-463, D. 1963.

The crystallographic properties of otoliths from 58 vertebrate species were investigated by means of polarization microscopy and x-ray diffraction. The otoliths occur as statoconia, microstatoliths, and statoliths. Usually only one kind is present in the labyrinth but in some vertebrates a combination of two or all three types may be found. While statoliths and microstatoliths always are polycrystalline, statoconia may either be polycrystalline or single crystals. Five different minerals, viz, apatite, calcite, aragonite,

vaterite and calcium carbonate monohydrate, compose the endogenous otoliths in the vertebrate labyrinth. Some elasmobranch have in addition exogenous statoconia consisting of sea-sand. The distribution of statoliths and/or statoconia, their texture and their composition within the vertebrate series, show remarkable consistencies; within each class the same kind of static bodies is usually present.

1253

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

POLARIZATION MICROSCOPY OF DENTAL ENAMEL WITH REFERENCE TO INCIPIENT CARIOUS LESIONS, by D. Carlstrom. [1963] [42]p. (AFOSR-64-1691) (AF EOAR-62-11) AD 447702   Unclassified

Also published in Advan. Oral Biol., v. 1: 255-296, 1963.

The aim of the present contribution is to indroduce the reader to some recent concepts of special interest for the future development of the polarization microscopy of dental tissues. Attention was paid to the different factors contributing to the polarized light image of dental enamel and to the advantages and disadvantages of the technique compared with other ultrastructural modes of investigation.

1254

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

GLOW, SENSITIVITY CHANGES AND PIGMENT MIGRATION IN THE COMPOUND EYE OF NOCTURNAL LEPIDOPTERA, by G. Hoglund. [1963] [6]p. (AFOSR-J1413) (AF EOAR-62-13) AD 427524   Unclassified

Also published in Life Sci., v. 2: 275-280, 1963.

In this investigation the size of the glowing area in the night moth's compound eye was recorded photographically. The photographs were used to correlate pigment position and electrophysiological measurements of the eyes' threshold at different stages of adaption. There was a gradual increase in the glowing area during the course of dark adaptation accompanied by a decrease in the threshold to light. The glowing area sometimes appeared during dark adaptation after the ganglia had been mechanically removed or treated with cocaine or nicotine. In these isolated retinae, as in the intact eyes, there was a relation between the size of the glowing area and the threshold, and the glowing area disappeared first in a locally illuminated part of the eye. These results suggest that essential functional properties of the intact eyes are at least temporarily retained after the abolition of the ganglionic activity.

1255

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

ON THE RELATION BETWEEN PIGMENT POSITION AND LIGHT SENSITIVITY OF THE COMPOUND EYE IN DIFFERENT NOCTURNAL INSECTS, by C. G. Bernhard, G. Hoglund, and D. Ottoson. [1963] [14]p. (AFOSR-64-0902) (AF EOAR-62-13) AD 439980   Unclassified

Also published in Jour. Insect Physiol., v. 9: 573-586, 1963.

In contrast to the rapid smooth dark-adaptation curve of day-flying insects lacking migratory secondary iris pigment, the adaptation curve of nocturnal moths and other night-flying insects, equipped with migratory secondary iris pigment, has in principle a diphasic course. During the second phase the eyes of the latter group acquire a considerably higher sensitivity than the dark-adapted eyes of the insects lacking secondary iris pigment. In comparative electrophysiological and histological investigations further evidence is presented for the conclusion that the second phase of the dark-adaptation curve is due to the migration of the secondary iris pigment from dark position to light position. The prerequisites for the appearance of the pigment migration and the second phase of the dark-adaptation curve are discussed. The variations in latency and temporal course of the second phase in the same species, and in different species, are discussed and attributed to variations in the time course of the secondary iris pigment migration.

1256

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

RECEPTOR SENSITIVITY AND PIGMENT POSITION IN THE COMPOUND EYE OF NOCTURNAL LEPIDOPTERA, by G. Hoglund. [1963] [4]p. (AFOSR-64-1713) (AF EOAR-63-7) AD 448267   Unclassified

Also published in Life Sci., v. 2: 862-865, 1963.

Recent investigations on nocturnal moths have shown the relation between the position of the secondary pigment and the sensitivity of the eye. The results of the present investigation suggest that the threshold changes in darkness are due to variations in the light reduction caused by changes in the pigment position, while the receptor sensitivity remains constant. During illumination the light reducing effect of the pigment when located proximally causes the receptors to become adapted to an illumination lower than the light intensity to which the eye is exposed. The receptor adaptation thus compensates for the reduction of the light. This suggests that constantly illuminated eyes possess larger quantities of photochemical substance if the pigment is positioned proximally than if the pigment is located distally or absent.

1257

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

INSECT CORNEAL NIPPLE ARRAY—A NATURAL IMPEDANCE TRANSFORMER (Abstract), by W. H. Miller, C. G. Bernhard, and A. R. Möller. [1964] [2]p. (AFOSR-64-2014) (AF EOAR-63-7)
Unclassified

Presented at Spring meeting of the Opt. Soc. of Amer., Washington, D. C., 1964.

Also published in Jour. Opt. Soc. Amer., v. 54: 581-582, Apr. 1964.

Measurements were made of microwave energy reflected from the front surface of, and transmitted through, models both possessing and lacking the nipple array. When the ratio of microwavelength to center-to-center spacing of the nipples was less than 1.5, the array produced an interference phenomenon resulting in zones of increased and decreased transmitted energy. For ratios between 1.5 and 5.0 (light wavelengths of 300 mμ to 1.0 μ as translated to corneal dimensions), reflection from the model's nippled surface was reduced and transmission through the model was correspondingly increased. The reduced reflection probably aids camouflage, whereas the augmented transmission of light may increase the probability of seeing during night at threshold by 10% or more over insects not possessing the array. (Contractor's abstract, modified)

1258

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

DISTRIBUTION OF BIOLOGICALLY ACTIVE COMPOUNDS IN THE BODY, by U. S. von Euler. Final rept. Feb. 29, 1964, 5p. (AFOSR-64-0841) (AF EOAR-62-14) AD 438395   Unclassified

The work carried out under this contract has been largely centered around problems concerning the uptake, release and storage of catecholamines in adrenergic nerves and in isolated storage granules from nerves and chromaffin cells. Another part of the activity has been devoted to studies of the response of the peripheral vascular system to vasoconstrictor agents under the action of respiratory acidosis. Six papers have been prepared and accepted for publication.

1259

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

TRANSMITTER STORAGE GRANULES OF ADRENERGIC NERVES, by U. S. von Euler. [1963] [14]p. (AFOSR-64-1066) (AF EOAR-62-14) AD 441503
Unclassified

Also published in Actualities Neurophysiol., v. 5: 37-50, 1963.

Electron microscopy and fluorescence histochemistry have demonstrated neural transmitter amines in knob-shaped structures in adrenergic nerve endings. Granules within these knobs contain the transmitter in a bound form. When stored at room temperature, they lose the amines exponentially, and the rate of loss is enhanced in acid or detergent solutions. Partly depleted granules can take up new transmitter molecules ATP and ADP, but not AMP, prevent depletion and stimulate amine uptake, by a mechanism which is not well known. Adrenaline and noradrenaline compete for binding sites on the granules. Phenoxybenzamine slows amine release, while tyramine enchances it. Reserpine in large concentrations causes a release, but in low concentrations it retards the release of amines without inhibiting spontaneous uptake. It does inhibit the ATP and magnesium dependent uptake. A postulated mechanism of adrenergic neural transmission is presented.

1260

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

THE INFLUENCE OF CHLORPROMAZINE ON THE CATECHOLAMINE EXCRETION OF NORMAL AND COLD ACCLIMATED RATS, by G. E. Johnson. [1964] [8]p. (AFOSR-64-1067) (AF EOAR-62-14) AD 441486
Unclassified

Also published in Acta Physiol. Scand., v. 60: 181-188, 1964.

Chlorpromazine was administered to normal rats placed at 30° and 20°C and to cold acclimated rats exposed to 30° and 2°C. Treatment of the animals at 30° produced no increase in catecholamine excretion. However, rats placed at either 20° or 2° significantly increased their noradrenaline excretion, and to a lesser extent their adrenaline excretion, following chlorpromazine. These increases, also noted in adrenalectomized rats and associated with hypothermia, could be prevented by pretreatment with a ganglionic blocker. It is concluded that the increase in noradrenaline excretion is a result of a temporary hypothermia produced by chlorpromazine and originates from sympathetic nerve endings.

1261

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

THE EFFECT OF COLD EXPOSURE ON THE CATECHOLAMINE EXCRETION OF ADRENALECTOMIZED RATS TREATED WITH RESERPINE, by G. E. Johnson. [1963] [7]p. (AFOSR-64-1068) (AF EOAR-62-14) AD 441485   Unclassified

Also published in Acta Physiol. Scand., v. 59: 438-444, 1963.

Adrenalectomized rats subjected to moderate cold exposure showed a significant increase in noradrenaline

excretion in urine. Adrenalectomized rats, treated
with reserpine, however, failed to respond with an
increase in the noradrenaline excretion during cold
stress. A fall in the noradrenaline excretion of the
reserpinized animals was usually followed by death.
These results suggest that reserpine treatment inhibits
the synthesis of noradrenaline in vivo and that the
survival of moderately cold stressed adrenalectomized
animals is related to the secretion of noradrenaline.

1262

Karolinska Inst. [Dept. of Physiology] Stockholm
(Sweden).

UPTAKE OF RADIOACTIVELY LABELED DL-
CATECHOLAMINES IN ISOLATED ADRENERGIC
NERVE GRANULES WITH AND WITHOUT RESERPINE,
by U. S. von Euler, L. Stjarne, and F. Lishajko.
[1963] [8]p. (AFOSR-64-1069) (AF EOAR-62-14)
AD 441504   Unclassified

Also published in Life Sci., v. 2: 878-885, 1963.

When incubated in vitro the isolated catecholamine
storage granules from bovine splenic nerves give off
their amines at a rate which is mainly a function of
the temperature. By addition of noradrenaline (NA)
in about 5×10^{-5} M concentration to the external med-
ium, the amine content of the granules is maintained
at a high level. It is not known whether this effect
depends on inhibition of the spontaneous release or is
due to an exchange reaction, exogenous amines moving
into the granules at a rate balancing the flow in the
opposite direction of endogenous amines. A high intra-
granular level of catecholamines mah also be main-
tained by addition of certain drugs in low concentrations
such as reserpine. In the present investigation the
mechanisms of these two types of protective effect on
the amine content of the nerve granules have been
studied using radioactively labeled catecholamines.

1263

Karolinska Inst. [Dept. of Physiology] Stockholm
(Sweden).

CATECHOLAMINES AND NUCLEOTIDES IN PHAEO-
CHROMOCYTOMA, by L. Stjarne, U. S. von Euler,
and F. Lishajko. [1964] [10]p. (AFOSR-64-2154)
(AF EOAR-62-14) AD 452040   Unclassified

Also published in Biochem. Pharmacol., v. 13: 809-
818, 1964.

Isolated catecholamine (CA) storage granules from a
phaeochromocytoma were studied in vitro. The tumor
granules had a high NA content, while A amounted to
only a few percent of the total CA. Most of the amines
were particle bound. The storage granules had a lower
density and adrenine nucleotide content than bovine ad-
renal medullary granules. Thus only a minor part
of the CA in this tumor could be stored by a mechanism
requiring stoichiometric relationship between amines
and adenine nucleotides. On incubation in vitro ATP
was lost at a slightly higher rate than the CA, leading

to an increase in the molar CA/ATP ratio. The ATP
lost was quantitatively recovered as AMP in the extra-
granular medium. ATP-splitting activity occurred to
some extent in the particle-free supernatant but was
more evident in the high speed sediment.

1264

Karolinska Inst. Dept. of Physiology, Stockholm
(Sweden).

EFFECTS OF RESERPINE, SEGONTIN AND PHENOXY-
BENZAMINE ON THE CATECHOLAMINES AND ATP
OF ISOLATED NERVE AND ADRENOMEDULLARY
STORAGE GRANULES, by U. S. von Euler, L. Stjarne,
and F. Lishajko. [1964] [6]p. incl. diagrs. refs.
(AFOSR-65-0944) (AF EOAR-62-14) AD 617815
                                    Unclassified

Also published in Life Sci., v. 3: 35-40, 1964.

The effects of 3 compounds, reserpine, segontin, and
phenoxybenzamine, are compared on the amine and ATP
content of the catecholamine storage granules from
adrenergic nerve and from adrenal medullary tissues.
The inhibition of outflux from the nerve granules caused
by reserpine applies selectively to the catecholamines,
while the spontaneous loss of ATP is not affected. The
effects of Segontin resemble those of reserpine. Phen-
oxybenzamine added to nerve storage granules maintains
a high level of amines and ATP. Adrenal medullary
granules incubated with this compound produce an
opposite effect. At a somewhat higher concentration,
phenoxybenzamine causes a considerable loss of both
amines and ATP.

1265

Karolinska Inst. Dept. of Physiology, Stockholm
(Sweden).

UPTAKE OF L- AND D-ISOMERS OF CATECHOL-
AMINES IN ADRENERGIC NERVE GRANULES, by U.
S. von Euler and F. Lishajko. [1964] [6]p. incl. tables,
refs. (AFOSR-65-0945) (AF EOAR-62-14) AD 617983
                                    Unclassified

Also published in Acta Physiol. Scand., v. 60: 217-222,
1964.

The spontaneous depletion of endogenous noradrenaline
(NA) from bovine splenic nerve granules is diminished
or prevented by incubation with either L-NA or D-NA.
However, the effect observed following the addition of
L-NA is significantly greater than that produced by the
D-isomer. No significant difference is observed be-
tween the uptake of the 2 isomers of adrenaline (A) in
undepleted granules. The enhanced uptake of A or NA
in a concentration of 10 μg/ml in the presence of ATP
similarly did not differ for the L- and D-isomers of
the amine. However, the ATP-dependent uptake at an
amine concentration of 1 μg/ml was 2-3 times as high
as for L-NA and L-A than for the D-isomers. It is
concluded that the ATP-dependent uptake in nerve
granules of NA and A at low amine concentrations is to
some extent stereospecific, while the amine-uptake at

higher concentrations with and without added ATP is not or only slightly dependent on the steric configuration. (Contractor's abstract)

1266

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

EFFECT OF TYRAMINE, RESERPINE AND COCAINE ON THE NORADRENALINE RELEASE AND UPTAKE OF THE PERFUSED RABBIT KIDNEY, by A. Inouye and I. Tanaka. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-65-1540) (AF EOAR-62-14) AD 623381
Unclassified

Also published in Acta Physiol. Scand., v. 62: 359-363, 1964.

Perfusion of isolated rabbit kidneys for 120-150 min with Tyrode solution containing 0.05% iproniazide caused no change of the normal noradrenaline (NA) content. Addition of NA to the perfusion fluid caused an uptake of NA approximately proportional to the NA concentration. The major part of the NA retained was removed by subsequent perfusion with NA-free Tyrode solution. Perfusion with tyramine 10^{-4} m removed a large part of the renal NA, even in the presence of NA in the perfusion fluid. Reserpine 4×10^{-6} m did not significantly release NA or alter the renal NA content, but diminished the NA uptake from a solution containing NA. Cocaine caused a moderate release of NA and partially prevented the NA uptake while it hardly caused any loss in the renal NA content, suggesting some NA resynthesis. (Contractor's abstract)

1267

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

THE DISTRIBUTION OF NORADRENALINE AND ADRENALINE IN THE FALLOPIAN TUBE OF THE RABBIT, by J. Brundin. [1964] [4]p. incl. diagr. table, refs. (AFOSR-65-1542) (AF EOAR-62-14) AD 624009
Unclassified

Also published in Acta Physiol. Scand., v. 62: 156-159, 1964.

The present study was undertaken in an attempt to explain the functional difference between the isthmic and ampullary regions of the oviduct in the rabbit by a difference in the distribution of their adrenergic nerve supply. The isthmus contains considerable amounts of noradrenaline (NA), while the NA contents of the ampulla and uterus are low. Adrenaline (A) was found in low concentrations in all of the preparations studied. Some implications of the distribution of NA in the different regions are discussed. (Contractor's abstract)

1268

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

SOME MORPHOLOGICAL FEATURES OF CATECHOLAMINE STORING NERVE VESICLES, by U. S. von Euler and G. Swanbeck. [1964] [2]p. incl. illus. (AFOSR-65-1302) (AF EOAR-64-31) AD 620829
Unclassified

Also published in Acta Physiol. Scand., v. 62: 487-463, 1964.

Subcellular particles rich in noradrenaline have been obtained from homogenized bovine splenic nerves. After staining with phosphotungstic acid, the existence of granules $0.03-0.1 \mu$ in diam was noted. A characteristic feature is the occurrence of notches, which often were extended to tail-like structures on opposite sides of the granules. Frequently the vesicles occurred in pairs and sometimes even in short chains. This is suggestive of a system similar to granular formation in the Golgi apparatus, which might mean that the granules are arranged in a type of lattice in the axon, and presumably in the terminals.

1269

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

SINGLE UNIT ACTIVITY IN THE RABBIT LATERAL GENICULATE BODY DURING EXPERIMENTAL EPILEPSY, by U. Soderberg and G. B. Arden. 1964, 10p. incl. diagrs. refs. (AFOSR-2908) (AF 61(052)-119) AD 632098
Unclassified

The activity of single cells of the rabbit lateral geniculate body was studied and related to various states of wakefulness and to cortical seizures that developed spontaneously after activation with flickering light, moderate hyperventilation or after the administaation of bemegride. Bemegride increases the firing rate of geniculate cells both in the dark and when the retina is stimulated with flickering light. Bemegride counteracts the depressing effect of sodium pentobarbital. In spontaneously occurring epilepsy in encephale isole animals with acute cortical lesions, and after photic activation in these animals, there is a long-lasting marked inhibition of geniculate activity. This inhibition does not prevent flickering light from influencing cortical activity. The firings are discussed in relation to previous investigations on the relation between specific and nonspecific visual pathways. (Contractor's abstract, modified)

1270

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

RESEARCH ON BRAIN STEM MECHANISMS REGULATING AUTONOMIC ACTIVITIES, by U. Soderberg. Final technical rept. Feb. 5, 1964, 18p. (AFOSR-64-0733) (AF 61(052)119) AD 438640
Unclassified

Some neurophysiological aspects of the regulation of the homeostasis by the central nervous system have been studied and will be described. Attempts have also been made to analyze how such adjustments and how inefficient regulation due to inertial or pathological conditions can influence cerebral activities. Special emphasis has been laid on technical problems. The employment of the neuronally isolated cortex as an index of how the cortical tissue reacts to blood-borne influences is described. Brain-stem activities that are especially involved in autonomic functions and in particular in the arousal phenomenon are discussed.

1271

[Karolinska Inst.] Nobel Inst. for Neurophysiology, Stockholm (Sweden).

NEUROPHYSIOLOGICAL ASPECTS OF HOMEOSTASIS, by U. Soderberg. [1964] [18]p. (AFOSR-64-1170) (AF 61(052)119) AD 442789   Unclassified

Also published in Ann. Rev. Physiol., v. 25: 271-288, 1964.

This report discusses the neurophysiological aspects of the regulation of homeostasis by and within the central nervous system and further, to describe how adjustments and inefficient regulation, due to inertia or pathological conditions, can influence cerebral activities. Homeostasis was taken in its broad sense, which means that behavioral problems were briefly mentioned as well. Since the activities of the subdivisions of the autonomic nervous system are as a rule so closely interrelated attempts at describing each entity separately have only rarely been made.

1272

Keele U. Dept. of Communication, Staffordshire (Gt. Brit.).

NEW METHODS OF ANALYSIS OF ELECTROPHYSIO-LOGICAL RESPONSES, by D. M. Mackay, D. A. Jeffreys, and R. R. Glover. June 21, 1963, 1v. incl. diagrs. (AFOSR-5257) (AF EOAR-62-23) AD 416363   Unclassified

This report describes a further year's work on the magnetic-tape averaging system. Effort has been devoted mainly to improving circuitry and developing auxiliary equipment, but a number of experiments on the occipital response to changes in visual pattern are also reported. (Contractor's abstract)

1273

Kent State U. Dept. of Chemistry, Ohio.

A NEW APPROACH TO MEASUREMENT OF DIPOLE MOMENT AND ELECTROLYTES IN PURE ACETIC ACID, by R. T. Myers. Final rept. Apr. 1959-Dec. 1964, 8p. incl. diagr. (AFOSR-65-0366) (AF 49(638)-641) AD 612040   Unclassified

In the method introduced here interpolations, rather than extrapolations, are used, and the value obtained in solution for dipole moment is apparently the same as that in the gas phase, within the experimental error of measurements of the latter. The chief reason for inability to make a definite statement here is the discordant data for dipole moments.

1274

Laval U., Quebec (Canada).

NEUROHUMORAL CONTROL OF THYROTROPIC
ACTIVITY, by C. Fortier. Final rept. Oct. 1, 1960-
May 31, 1963, 1v. incl. illus. diagrs. tables, refs.
(AFOSR-4995) (AF AFOSR-61-15) AD 414858
Unclassified

The results of this investigation indicate that (1) Stress,
as exemplified by surgical trauma or faradic stimula-
tion, in addition to stimulating ACTH secretion, simul-
taneously depresses the synthesis and release of TSH,
but has no effect on the removal rate of circulating TSH.
(2) Prior adrenalectomy does not influence the TSH
response to stress which is therefore not mediated by
corticosteroids, or by catecholamines of medullary
origin. (3) Thyroidectomy slows down the disappear-
ance rate of circulating TSH, in addition to stimulating
TSH secretion. (4) Adrenalectomy depresses both the
rate of secretion of TSH and its rate of removal from
the circulation. (5) Small and larger doses of triiodo-
thyronine respectively enhance the synthesis and block
the release of TSH in the thyroidectomized animal.
(Contractor's abstract, in part)

1275

Laval U., Quebec (Canada).

EFFECT OF LOCALIZED DESTRUCTION OF THE
VENTRAL HYPOTHALAMUS ON THE ADRENOCORTI-
COTROPIC RESPONSES TO SURGICAL TRAUMA AND
TO HYPOCORTICOIDISM IN THE RAT, by C. Fortier
and J. de Groot. [1964] [1]0p. incl. diagrs. tables,
refs. (AFOSR-66-0961) (AF AFOSR-61-15)
AD 634490   Unclassified

Also published in Major Problems in Neuroendocrinol-
ogy; Internat'l. Symposium, Montreal U. (Canada), ed.
by E. Bajusz and G. Jasmin. Basel, S. Karger, 1964,
p. 220-229.

The adrenal corticosterone response to unilateral
adrenalectomy, as well as the 16-day pituitary ACTH
response to bilateral adrenalectomy, were suppressed,
in the rat, by electrolytic destruction of the bulbous
portion of the Median Eminence or of premammillary an
and mammillary structures. It is inferred therefore
that the hypothalamus plays an essential role in the
mediation of the adrenocorticotropic responses to stress
and to hypocorticoidism. (Contractor's abstract)

1276

Laval U., Quebec (Canada).

RESIDUAL SYNTHESIS AND RELEASE OF ACTH
FOLLOWING ELECTROLYTIC DESTRUCTION OF THE
MEDIAN EMINENCE IN THE RAT, by C. Fortier and
J. de Groot. [1964] [17]p. incl. illus. diagrs. tables,
refs. (AFOSR-66-0965((AF AFOSR-61-15)
AD 634454   Unclassified

Also published in Major Problems in Neuroendocrin-
ology; Internat'l. Symposium, Montreal U. (Canada),
ed. by E. Bajusz and G. Jasmin. Basel, S. Karger,
1964, p. 203-219.

In order to assess the degree of hypothalamic involve-
ment in the maintenance of basal adrenocorticotropic
activity, changes in adenohypophysial ACTH, plasma
corticosterone, adrenal corticosterone and ascorbic
acid, in vitro corticoidogenesis and corticoidogenic
response to ACTH, as well as in pituitary and adrenal
weight, were studied, as ordinates of time, over a two
month period following electrolytic destruction of the
bublus of the Median Eminence in the rat. From a
correlation of the pituitary ACTH data with information
pertaining to the concentration of the hormone in the
blood, it appears that ACTH synthesis, initially de-
pressed following the short burst of secretory activity
induced by the surgical procedure, temporarily re-
covers from this depression, and undergoes thereafter
a progressive decline of two-week duration, ascribed
as was the depressed rate of release, to the disappear-
ance of CRF and to ischemia. Stabilization, thereupon,
of the synchronized rates of synthesis and release is
interpreted as evidence that residual corticotrophic
activity is compatible with the exclusion of hypothalamic
influence presumably achieved by complete destruction
of the bulbus of the Median Eminence. (Contractor's
abstract)

1277

Laval U., Quebec (Canada).

NEUROHUMORAL CONTROL OF THYROTROPIC
ACTIVITY, by C. Fortier. Final progress rept.
June 1-Sept. 30, 1963, 4p. (AFOSR-64-0017) (AF AF-
OSR-62-6) AD 429274   Unclassified

This work has been directed at elucidating some of the
problems arising out of our continuing studies on pitui-
tary-thyroid-adrenocortical interactions; initiating a
new project on the endocrine basis of adaptation to cold;
setting up and adapting techniques for assessing the
equilibrium distribution between native and protein-
bound plasma corticosterone, and for determining
plasma thyroxine.

1278

Laval U., Quebec (Canada).

[ACTH RELEASE AND SYNTHESIS IN THE ACUTELY
STRESSED ADRENALECTOMIZED RAT] Syntnese et
liberation d'ACTH a la suite d'une agression aigue chez
le rat surrenalectomise, by P. Ducommun, S.
Ducommun and others. [1964] [2]p. incl. diagr. table,
refs. (AFOSR-66-0960) (AF AFOSR-64-511)
AD 634555   Unclassified

Also published in Schweiz. Med. Wochenschr., v. 94:
892-893, 1964.

Laparotomy under ether anesthesia in the adrenalec-
tomized female rat resulted in a transient increase in
blood ACTH, reaching its peak after 5 min and returning

to normal within 20 min. Contrary to recent findings by Vernikos-Danellis, no increase in pituitary ACTH could be detected in the first 10 postoperative minutes. This militates against the theory of the predominance of ACTH synthesis under the effects of stress. The subsequent fall in pituitary ACTH observed concurrently with the continuing fall in blood ACTH is ascribed to the fact that ACTH synthesis is more markedly inhibited than ACTH release at this later stage of stress response. (Contractor's abstract)

1279

Laval U., Quebec (Canada).

[EFFECTS OF ACTH AND LYSINE-VASOPRESSIN ON CORTICOSTERONE SYNTHESIS AND RELEASE IN THE RAT] Actions de l'ACTH et de la lysine-vasopressine sur la synthese et la liberation de la corticosterone chez le rat, by C. Mialhe-Voloss, B. Koch and others. [1964] [4]p. incl. diagrs. refs. (AFOSR-66-0963) (AF AFOSR-64-511) AD 634566
Unclassified

Also published in Rev. Canad. Biol., v. 23: 469-472, Dec. 1964.

Progressive doses of ACTH and of highly purified lysine-vasopressin were added to rat adrenal glands incubated in vitro for a comparison of their effects on the synthesis and release of corticosterone, through determination of the steroid in the gland and in the incubating fluid. ACTH increased the concentration of corticosterone in the adrenal tissue, as well as in the incubating fluid. The increase was linearly related to the log dose of ACTH over a range of 3 to 48 μ/100 mg. By contrast, lysine-vasopressin had no effect on the adrenal corticosterone concentration. A transient effect on the corticosterone concentration of the medium, recorded after 15 min of incubation at a dose level of 12,800 μ/100 mg, is ascribed to leakage of the steroid, as opposed to altered steroidogenesis. (Contractor's abstract)

1280

Laval U., Quebec (Canada).

EFFECT OF CHRONIC ACTH ADMINISTRATION ON THE ADRENOCORTICOTROPIC RESPONSE TO BILATERAL ADRENALECTOMY IN THE RAT, by P. Ducommun, C. Mialhe-Voloss, and C. Fortier. [1964] [3]p. incl. table, refs. (AFOSR-66-0964) (AF AFOSR-64-511) AD 634567
Unclassified

Also published in Rev. Canad. Biol., v. 23: 443-445, Dec. 1964.

Treatment with large doses of a long-acting ACTH preparation over a period of four weeks following bilateral adrenalectomy in the rat did not significantly alter the rise in pituitary ACTH concentration consequent to adrenalectomy. The weighted mean of four separate assays of an extract of pooled pituitaries from ACTH-treated adrenalectomized animals against a similar extract from adrenalectomized controls was

114.5%, with 95% confidence limits of 96.8 and 135.5. These results do not support the alleged involvement of circulating ACTH in the adjustment of its synthesis or release by the pituitary. (Contractor's abstract)

1281

Laval U., Quebec (Canada).

RELATIVE BINDING OF CORTICOSTERONE BY TRANSCORTIN AND ALBUMIN AS A FUNCTION OF TOTAL PLASMA CORTICOSTERONE CONCENTRATION (Abstract), by F. Labrie, J. P. Raynaud, and C. Fortier. [1964] [1]p. (AFOSR-66-2464) (AF AFOSR-64-511) AD 643140
Unclassified

Also published in Federation Proc., v. 23, Mar.-Apr. 1964.

Following incubation at 37°C of increasing amounts of C^{14}-corticosterone with adrenalectomized rat plasma, distribution of the steroid between its native form and transcortin- and albumin-bound moieties was studied as a function of total concentration by concurrent utilization of gel filtration and equilibrium dialysis. Separation of the transcortin-bound fraction was achieved by eluting plasma through Sephadex with phosphate buffer at 37°C. Results were corrected for dilution effect and for dissociation of the transcortin-corticosterone complex inherent to procedure. The native/total protein-bound corticosterone ratio was obtained from equilibrium dialysis of undiluted plasma against 0.9% saline, at 37°C. Assessment of the albumin-bound fraction was derived from the difference between results of the two procedures. (Contractor's abstract, modified)

1282

Laval U., Quebec (Canada).

RELATIVE BINDING OF CORTICOSTERONE BY TRANSCORTIN AND ALBUMIN, AS DETERMINED BY GEL-FILTRATION AND EQUILIBRIUM DIALYSIS (Abstract), by J. P. Raynaud, F. Labrie, and C. Fortier. [1964] [1]p. (AFOSR-66-2465) (AF AFOSR-64-511) AD 643141
Unclassified

Also published in Proc. Canad. Federation Biol. Soc., v. 7: 44, 1964.

Following incubation, at 37°C, of increasing amounts of C^{14} corticosterone with adrenalectomized rat plasma, distribution of the steroid between its native form and its transcortin and albumin-bound moieties was studied as a function of total concentration, by the concurrent utilization of gel-filtration and equilibrium dialysis. Separation of the transcortin-bound fraction was achieved by eluting the plasma through a G 25 coarse Sephadex column with phosphate buffer, at a constant temperature of 37°C. The results were corrected for the dilution effect and for the dissociation of the transcortin-corticosterone complex inherent to the gel-filtration procedure. By concurrently measuring the transcortin-bound and the total protein-bound corticosterone fractions, the adverse effect on binding of

increasing the dilution of the plasma could be quanti-
tated, and an appropriate correction factor derived.
(Contractor's abstract, modified)

1283

Laval U., Quebec (Canada).

INFLUENCE OF THYROID ACTIVITY ON CORTI-
COSTERONE BINDING BY PLASMA PROTEINS (Ab-
stract), by F. Labrie, J. P. Raynaud and others.
[1964] [1]p. (AFOSR-66-2469) (AF AFOSR-64-511)
AD 643138   Unclassified

Also published in Proc. Canad. Federation Biol. Soc.,
v. 7: 23, 1964.

Previous studies have suggested that thyroxine could
enhance the binding of corticosterone by plasma pro-
teins. To test this hypothesis, rats were sacrificed,
with untreated controls, four weeks after thyroidectomy
followed or not by daily administration of 20 µg of
thyroxine during the last two post-operative weeks;
half of the experimental and control animals being
exposed, 12.5 minutes prior to killing, to faradic stimu-
lation of 2-minute duration. Adrenal and total plasma
corticosterone were determined by a standard fluoro-
metric method. The distribution of corticosterone be-
tween its native form and the transcortin and albumin
bound moieties was studied. In confirmation of previous
results, thyroidectomy and thyroxine administration
were respectively found to lower and to increase the
basal secretion of corticosterone, as well as the corti-
coidogenic response to stress. (Contractor's abstract,
modified)

1284

Laval U., Quebec (Canada).

PITUITARY-THYROID RESPONSE TO COLD EXPOSURE
IN THE RAT (Abstract), by M. Jobin and M. Samel.
[1964] [1]p. (AFOSR-66-2470) (AF AFOSR-64-511)
AD 644914   Unclassified

Also published in Proc. Canad. Federation Biol. Soc.,
v. 7: 23, 1964.

Rats were sacrificed following progressively longer
periods (15 min to 24 hr) of exposure to moderate cold
(13°C) for determination of pituitary and plasma TSH
and of plasma thyroxine concentration. The plasma
TSH response to cold exposure was characterized by
a transient peak within 30 min, and a secondary rise
to elevated levels over the remainder of the observati
period. No appreciable rise of plasma thyroxine was
observed for less than 4 hr of exposure. Elevated
values were recorded from then on. No definite re-
sponse pattern was observed with regard to pituitary
TSH. A diurnal variation in plasma thyrotropic activity
was suggested in this experiment. This tendency was
confirmed in a separate experiment. A third experi-
ment in which the plasma TSH responses to cold of
graded intensities (20°, 14°, 8° and 2°C) were compared,
revealed a maximum stimulatory effect for temperatures
of 8° and 2°C. (Contractor's abstract, modified)

1285

Lehigh U. Center for the Information Sciences,
Bethlehem, Pa.

AN EMPIRICAL TESTING PROGRAM FOR MODELS
OF INFORMATION STORAGE AND RETRIEVAL SYS-
TEMS, by D. J. Hillman. Final rept. July 1, 1963-
June 30, 1964. Nov. 6, 1964, 10p. (AFOSR-64-2385)
(AF AFOSR-64-462) AD 608704   Unclassified

A small scale experimental program was undertaken to
compare the efficiency of a retrieval system based on
a Boolean model with that of a system based on a nega-
tion-free or incomplemented model. The results of the
experiment are described.

1286

Lehigh U. Dept. of Mathematics, Bethlehem, Pa.

VECTOR FIELDS AND INFINITESIMAL TRANSFORMA-
TIONS ON RIEMANNIAN MANIFOLDS WITH BOUND-
ARY, by C.-C. Hsiung. 1963, 36p. incl. refs. (AFOSR-
4783) (AF AFOSR-62-206) AD 428685   Unclassified

Also published in Bull. Soc. Math. France, v. 92:
411-434, 1964.

Results of studies made of vector fields or infinitesimal
transformations on compact Riemannian manifolds with-
out boundary are extended to Riemannian manifolds with
boundary. Fundamental formulas for Lie derivatives
are given and the infinitesimal transformations and
their generating vector fields are defined in terms of
Lie derivatives. Necessary and sufficient conditions
for a vector field on a manifold with zero tangential or
normal component on a boundary to be a killing vector
field are given. Conditions are obtained for the non-
existence of a nonzero conformal killing vector field on
a manifold with zero tangential or normal component
on the boundary, and necessary and sufficient conditions
for a vector field on a manifold with zero tangential
or normal component on the boundary to be a conformal
killing vector field are obtained. It is shown that if the
manifold has constant scalar curvature and admits a
certain special infinitesimal nonhomothetic conformal
motion leaving the boundary invariant, then the curva-
ture is greater than zero.

1287

Leicester U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF SIMPLE CARBON COM-
POUNDS IN MICRO-ORGANISMS, by H. L. Kornberg.
Final technical rept. Oct. 31, 1963, 10p. incl. diagr.
refs. (AFOSR-J1454) (AF EOAR-62-77)
AD 427528   Unclassified

The main results obtained indicate that: both repres-
sion and inhibition of isocitrate lyase may be mediated
via phosphopyruvate; β-methyl β-hydroxyaspartate
may be cleaved by β-hydroxyaspartate aldolase; gly-
cine utilization by Arthrobacter sp. involves serine
and pyruvate, and not glyoxylate or glycerate, as
intermediates; tartronic semialdehyde reductase may

be involved in the racemization of D and L glycerate; Cl. kluyveri extracts may catalyze CO_2-fixation dependent on crotonyl-CoA; the utilization of aconate and itaconate proceeds by different metabolic routes, involving distinct and inducible enzymes; the decarboxylation of aspartate by crystalline aspartate 4-carboxy-lyase involves the intermediate formation of a secondary amine between the substrate and an enzyme - pyridoxal 5'-phosphate imine; and Ps. aeruginosa elaborates only one acyl transferase but the kinetics of its production depend on the nature of the inducer.

1288

Leicester U. [Dept. of Biochemistry] (Gt. Brit.).

THE UTILIZATION OF ITACONATE BY PSEUDO-MONAS SP, by R. A. Cooper and H. L. Kornberg. [1964] [10]p. (AFOSR-64-1133) (AF EOAR-62-77) AD 442994   Unclassified

Also published in Biochem. Jour., v. 91: 82-91, 1964.

This report describes a route of itaconate catabolism in Pseudomonas B2aba which is similar to that occurring in liver mitochondria. It was shown that washed suspensions of Pseudomonas B2aba, grown on itaconate, oxidized itaconate, DL-citramalate and mesaconate, but these substances were not oxidized by succinate-grown cells. Extracts of the itaconate-grown organism catalyzed the formation of pyruvate and acetyl-coenzyme A when incubated with itaconate, adenosine triphosphate, coenzyme A and Mg^2 ions. The formation of pyruvate and acetylcoenzyme A from DL-citramalate, in the presence of extract and Mg^{2+} ions, necessitated the presence either of succinate, coenzyme A and adenosine triphosphate, or of succinyl-coenzyme A. Both synthetic itaconyl-coenzyme A and enzymically produced citramalyl-coenzyme A yielded pyruvate and acetyl-coenzyme A in equimolar amounts.

1289

Leicester U. Dept. of Biochemistry (Gt. Brit.).

PURIFICATION AND PROPERTIES OF ACYL TRANS-FERASES FROM PSEUDOMONAS AERUGINOSA, by M. Kelly and H. L. Kornberg. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-2971) (AF EOAR-62-77) AD 628390   Unclassified

Also published in Biochem. Jour., v. 93: 557-566, 1964.

Two preparations of amidase, of similar final specific activities, were obtained from Pseudomonas aeruginosa 8602/A grown on acetate plus ammonia, and on acetamide, as carbon and nitrogen sources. The purified enzymes catalyzed the transfer of the acyl moieties of a number of aliphatic amides to water (amidase activity) and to hydroxylamine (amide-transferase activity); to a smaller extent they also catalyzed the transfer to hydroxylamine of the acyl moieties of several aliphatic acids (acid-transferase activity). Both enzymes exhibited the same substrate specificity. The ratios of the amidase, amide-transferase and acid-transferase activities exhibited by each enzyme varied in an identical

manner with different substrates. Both enzymes exhibited identical kinetic properties. The amidase activity of both enzymes was non-competitively inhibited by urea and by N-methylurea; these inhibitions were reversed by hydroxylamine. Thiourea did not inhibit. The amide-transferase and acid-transferase activities of both enzymes were inhibited by iodoacetate and by p-hydroxymercuribenzoate: the inhibition caused by the latter compound was reversed by cysteine.

1290

Leicester U. [Dept. of Chemistry] (Gt. Brit.).

THE EFFECT OF ADDED ELECTROLYTES ON THE E.S.R. AND OPTICAL ABSORPTION OF METAL-AMMONIA SOLUTIONS, by M. C. R. Symons. June 1964, 31p. (Scientific rept. no. 5) (AFOSR-64-2429) (AF EOAR-62-64) AD 609557   Unclassified

A confined model for the solvated electron is developed by analogy with related systems, and is used to describe the spectral properties of electrons trapped in various media. The nature of the diamagnetic species in metal solutions is discussed in view of the proposed model.

1291

Leicester U. [Dept. of Chemistry] (Gt. Brit.).

THE EFFECT OF ADDED ELECTROLYTES ON THE ELECTRON SPIN RESONANCE AND OPTICAL ABSORP-TION OF SOLUTIONS OF THE ALKALI METALS IN LIQUID AMMONIA, by R. Catterall. Final rept. Apr. 1964, 333p. incl. refs. (AFOSR-65-1938, Pt. 2) (AF EOAR-62-64) AD 627234   Unclassified

This is an informative annex to the final report AFOSR-65-1938, Pt. 1. A review of the development of the study of metal solutions is presented. Particular emphasis is placed on the various models proposed to describe the physical properties of these solutions. Electron spin resonance and optical absorption measurements are reviewed in detail.

1292

Leyden U. Lorentz Inst. (Netherlands).

BROWNIAN MOTION IN SYSTEMS OF FINITE SIZE, by I. Oppenheim and P. Mazur. [1964] [13]p. (AFOSR-65-0156) (AF EOAR-62-99) AD 611966
                                    Unclassified

Also published in Physica, v. 30: 1833-1845, 1964.

The solution of the Langevin equation for a Brownian particle in an arbitrary field of force in a finite system, in the presence of walls, is related to the solution of the Langevin equation for an infinite system. Analytic expressions for correlation functions of the momentum in the absence of an external field are obtained. The importance of the order of the $V \to \infty$ and $t \to \infty$ limiting processes is discussed. (Contractor's abstract)

1293

Leyden U. Lorentz Inst. (Netherlands).

ON THE STATISTICAL MECHANICAL THEORY OF
BROWNIAN MOTION, by P. Mazur and E. Braun.
[1964] [16]p. (AFOSR-65-1083) (AF EOAR-62-99)
AD 619645   Unclassified

Also published in Physica, v. 30: 1973-1988, 1964.

It is shown that a heavy particle in a 1-dimensional
assembly of harmonic oscillators performs Brownian
motion provided that the spectral density $G(\omega^2)$ of
eigenvalues ω^2 of the interaction matrix is proportional
to ω^{-1} for $\omega \to 0$. The interaction matrix may otherwise
be completely arbitrary. A generalization of this re-
sult to D-dimensional systems is given. (Contractor's
abstract)

1294

Library of Congress. Science and Technology Div.,
Washington, D. C.

AIR FORCE SCIENTIFIC RESEARCH BIBLIOGRAPHY.
VOL. II: 1957-1958, by G. V. Hooker, A. S. Dann
and others. 1964, 1103p. incl. illus. refs. (AFOSR-
64-0967; AFOSR-700, Vol. II) (ISSA-63-2) AD 446866
                               Unclassified

This bibliography includes abstracts of all publications
supported in whole or in part by the Air Force Office
of Scientific Research during the period 1957 through
1958. The Air Force Office of Scientific Research sup-
ports fundamental research in the five major scientific
disciplines: physics, chemistry, engineering sciences
(subsuming mechanics and propulsion), life sciences
(both biological and behavioral, but not medical), and
mathematics. References, reports, and clues to the
existence of reports were found by searching the
indexes and report collections of the AFOSR Technical
Library, and the Armed Services Technical Informa-
tion Agency. Reports are posted chronologically and/or
alphabetically under contracts, these in turn under
laboratories, and these under contractors. The ab-
stracts are coded for future machine searching. A de-
tailed subject index, arranged alphabetically, is pro-
vided. Because of the high percentage of mathematical
papers included in this volume, a separate mathematical
classification is included. In addition to the subject
indexes, a contract index, an AFOSR control number
index, and a personal author index are provided.

1295

Litton Systems, Inc. Space Sciences Labs.,
Beverly Hills, Calif.

RESEARCH ON ELECTROMAGNETIC PLASMA
ACCELERATION, by A. S. Penfold and R. M. Rosen.
Final rept. Dec. 15, 1959-Oct. 31, 1963. June 1964,
494p. incl. illus. diagrs. tables, refs. (Publ. no.
3484) (AFOSR-64-1340) (AF 49(638)759) AD 609482
                               Unclassified

Included in this report are the following: (a) An experi-
mental investigation of the acceleration of plasma
toroids in a pulsed traveling wave device. (b) A theo-
retical investigation of the behavior of plasma in axially
symmetric magnetic fields. (c) A detailed description
of a CW polyphase-driven traveling wave accelerator.
In addition there are a number of appendices describing
various ancillary techniques and apparatuses including
polyphase monitoring and control systems, an analog
computer for axially-symmetric magnetic fields, and
the CW power sources. (Contractor's abstract)

1296

Lockheed Aircraft Corp. [Missiles and Space Div.]
Sunnyvale, Calif.

LAMINAR FLAME THEORY AND THE STEADY,
LINEAR BURNING OF A MONOPROPELLANT, by W.
E. Johnson and W. Nachear. [1963] [35]p. (AFOSR-
J476) (AF 49(638)412) AD 408216   Unclassified

Also published in Arch. Rational Mech. and Anal.,
v. 12: 58-92, 1963.

The principal purposes of this paper are to analyze
rigorously the eigenvalue problem, to demonstrate
existence and uniqueness of solutions, and to discuss
certain aspects of the qualitative behavior of solutions.
The formulation of the eigenvalue problem from physical
laws, and the subsequent analysis of this problem will
be such that no special form for the chemical-reaction-
rate law, or chemical source function, need be
assumed. In particular, the results will be applicable
to the phenomenological mass-action law for a one-step,
reversible, chemical reaction involving an arbitrary
number of species, in arbitrary initial ratios, and with
specific reaction-rate coefficients dependent upon tem-
perature in the form of the Arrhenius laws.

1297

Lockheed Aircraft Corp. Missiles and Space Div.,
Sunnyvale, Calif.

THE EFFECTS OF PARTICLE SIZE AND NON-
STOICHIOMETRIC COMPOSITION ON THE BURNING
RATES OF COMPOSITE SOLID PROPELLANTS, by W.
Nachbar and G. B. Cline, Jr. [1963] [18]p. incl. diagrs.
table. (AF 49(638)412)   Unclassified

Published in Combustion and Propulsion; Fifth AGARD
Colloq. on High-Temperature Phenomena, Braunschweig
(Germany) (Apr. 9-13, 1962), ed. by R. P. Hagerty,
A. L. Jaumotte and others. New York, MacMillan Co.,
1963, p. 551-568.

Analysis of the steady burning of a composite solid
propellant of sandwich construction, which has been
proposed previously (see item no. LOC. 01:004, Vol.
II) as a mathematical model with which to investigate
steady burning, is generalized to include non-stoichio-
metric proportions of fuel and oxidizer. The theoretical
dependence of burning rate upon "particle size" and upon
stoichiometry is obtained and is illustrated by calcula-
tions with data for 2 composite solid propellants. A

rough qualitative comparison is made of the theoretical predictions with some published experimental data.

1298

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

A GENERALIZATION OF FIELD QUANTIZATION AND STATISTICS. II. INTERACTING FIELDS, by S. Kamefucht and J. Strathdee. [1963] [11]p. incl. table, refs. (AFOSR-J799) (A F EOAR-62-87) AD 413559   Unclassified

Also published in Nuclear Phys., v. 42: 166-176, Apr. 1963.

The generalized method of quantization developed in a previous paper is extended via suitable modifications of the usual commutation relations between different fields so as to allow the incorporation of interactions. A consequence of the structure of these modified commutation relations is the existence of a supperselection rule concerning the numbers of particles of each statistical type. By means of this super-selection rule and of some quantitative consequences of the theory, one is able to establish that all of the known elementary particles obey either Fermi-Dirac or Bose-Einstein statistics. (Contractor's abstract)

1299

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

MASSIVE ELECTRODYNAMICS, by G. Feldman and P. T. Matthews. [1963] [6]p. incl. refs. (AFOSR-J800) (AF EOAR-62-87) AD 413525   Unclassified

Also published in Phys. Rev., v. 130: 1633-1638, May 15, 1963.

The relation between gauge invariance, canonical quantization, and the photon mass is examined. It is found that gauge invariance does not require the bare photon mass to be zero. In fact, quantization in an arbitrary covariant gauge is only possible for massive photons. This is a generalization of the usual Fermi procedure. A similar generalization of the conventional Coulomb gauge quantization leads to a gauge-invariant, but noncovariant, theory of massive transverse photons.

1300

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

FEYNMAN RULES FOR REGGE PARTICLES, by T. W. B. Kibble. [1963] [10]p. (AFOSR-64 0365) (AF EOAR-62-87) AD 434527   Unclassified

Also published in Phys. Rev., v. 131: 2282-2291, Sept. 1, 1963.

The analogy between Regge poles and poles due to single-particle exchange is extended to the case of many-particle amplitudes, by considering diagrams with two or more poles. A set of diagrams is obtained in which the internal lines represent Regge particles. The problem of coupling three particles of arbitrary but physical spin is treated first, and coupling constants depending on the helicities are defined. The vertex functions which couple three Regge particles, and which have a similar symmetry properties, are defined in terms of the residues of Regge poles. The propagator for a Regge particle with trajectory $\alpha(t)$ is essentially a rotation matrix for spin α, corresponding to a rotation from the initial to the final direction of the center-of-mass momentum, divided by $\sin \pi(\alpha - \sigma)$, where σ is a constant which replaces the signature. The possibility of using this formalism to predict the high-energy behavior of production amplitudes is discussed, in particular, for single particle production.

1301

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

CANONICAL VARIABLES FOR THE INTERACTING GRAVITATIONAL AND DIRAC FIELDS, by T. W. B. Kibble. [1963] [5]p. (AFOSR-64-0521) (AF EOAR-62-87) AD 433827   Unclassified

Also published in Jour. Math. Phys., v. 4: 1433-1437, Nov. 1963.

The problem of reducing the Lagrangian for the interacting gravitational and dirac fields to canonical form is discussed, using the Vierbein formalism. The arbitrary gauge variables corresponding to local Lorentz transformations of the Vierbein are removed by imposing Schwinger's time-gauge condition, and a further condition that the spatial part of the Vierbein be symmetric. It is shown that in this gauge the Lagrangian can be expressed in a canonical form involving essentially the same gravitational field variables as in the absence of matter, and that the generators of spatial translations and rotations have the expected form.

1302

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

INTERACTION OF INTENSE LASER BEAMS WITH ELECTRONS, by L. S. Brown and T. W. B. Kibble. [1964] [15]p. incl. refs. (AFOSR-64-0865) (AF EOAR-62-87) AD 438649   Unclassified

Also published in Phys. Rev., v. 133: A705-A719, Feb. 3, 1964.

The interaction of an intense coherent photon beam with free electron is discussed. The photon beam is treated as a classical external electromagnetic field. The discussion is exact within the approximation of neglecting radiative corrections and the restriction to the case of a plane-wave field of arbitrary spectral composition and

polarization properties. The problem of the correct definition of the vacuum current is encountered, and it is shown that a careful procedure is necessary to obtain a covariant result. (Contractor's abstract, modified)

1303

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

DISTRIBUTION OF PIONS IN NUCLEON CLOUDS, by Q. A. M. M. Yahya. [1963] [13]p. (AFOSR-64-1007) (AF EOAR-62-87) AD 440987   Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 1487-1499, Dec. 16, 1963.

The fluctuation of pions in nucleon clouds is studied using statistical methods. The probability that in an interval of time certain number of pions would reach the physical nucleon cloud and be reabsorbed in the core is obtained in a method analogous to waiting time problem in statistics. The probability that a specified number of cloud states would be formed after some transitions of pions is found explicity by means of generating functions.

1304

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

REGGE-POLE THEORY OF THE PHOTOPRODUCTION OF PIONS, by N. Dombey. [1964] [12]p. (AFOSR-64-1155) (AF EOAR-62-87) AD 442842
Unclassified

Also published in Nuovo Cimento, Series X, v. 31: 1025-1036, Mar. 1, 1964.

In an attempt to apply a Regge-pole treatment to photo-production it was found that in order to obtain the de-sired results massive photons have to be introduced into the theory thus allowing effects arising from longitudinal polarization of the photon. A new set of invariant amplitudes for the electroproduction of pions naturally suggest themselves from these considera-tions.

1305

[London U.] Imperial Coll. of Science and Tech.

INTENSIVE OBSERVABLES IN QUANTUM THEORY, by R. F. Streater. [1964] [10]p. incl. refs. (AFOSR-64-2052) (AF EOAR-62-87) AD 452521
Unclassified

Also published in Jour. Math. Phys., v. 5: 581-590, May 1964.

The notion of strictly intensive observables is intro-duced in a theory of local observables. It is shown

that energy-momentum can never be strictly intensive. This result is used to prove that the algebras of ob-servables is not of Type I for some regions. By analogy with the energy-momentum tensor density for the free field, the definition is weakened. This leads to the introduction of germs of intensive observables. It is proved that the unitary intensive operators form a sheaf F of groups, and he Hermitian intensive operators form a sheaf G of Abelian groups.

1306

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

U-SPIN AND THE WEAK INTERACTION, by P. T. Matthews and A. Salam. [1964] [5]p. incl. diagr. table. (AFOSR-64-2548) (AF EOAR-62-87) AD 453830
Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1333-13337, Sept. 1, 1964.

The action of U-spin is applied to the semi-leptonic decays of the baryons. (Contractor's abstract)

1307

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

ON QUASI-FREE POLYLOCAL FIELDS AND FIELDS OF INFINITE SPIN, by R. F. Streater. [1964] [9]p. incl. refs. (AFOSR-65-0116) (AF EOAR-62-87) AD 455796   Unclassified

Also published in Ann. Phys., v. 30: 1-9, Oct. 1964.

A method is presented for constructing polylocal fields, depending on many space-time variables and similar to the generalized free field in 1 variable. A special case of the polylocal field may be said to correspond to a local field of infinite spin. The 1-particle state of such a theory is infinitely degenerate unless the 1-particle unitarity condition holds. In certain cases the existence of localized von Neumann algebras can be proved. The spacelike asymptotic condition in the form suggested by Haag and Ruelle holds, and so the interpretation of the theory in terms of asymptotic states may be expected. (Contractor's abstract, modified)

1308

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

πp PHENOMENOLOGY, (300 ÷ 1300) MEV, by P. Auvil and C. Lovelace. [1964] [47]p. incl. diagrs. tables, refs. (AFOSR-65-0117) (AF EOAR-62-87) AD 455633   Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 473-519, July 16, 1964.

Elastic scattering experiments from 300 to 1300 mev

are analyzed by various new or improved techniques. The usual D_{13} and F_{15} assignments for the second and third resonances are supported. The fourth resonance is found to be F_{37}, and the 800 mev π^+p shoulder to be D_{35} inelastic. There are also indications of 4 more inelastic shoulders: in P_{11} (~ 400 mev), S_{11} (~ 600 mev), D_{15} (~ 700 mev) and G_{17} (~ 1200 mev). Both S waves increase steadily with energy, indicating a strong repulsive core. The background at the fourth resonance is strongly spin-dependent, in contradiction to the usual diffraction model. The imaginary parts of the partial amplitudes are obtained quantitatively over much of this region. The most powerful new condition is the requirement that the elasticities of the resonances, as determined from total cross-sections and forward dispersion relations, be compatible with the differential cross-sections there. (Contractor's abstract)

1309

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

RENORMALIZABLE ELECTRODYNAMICS OF SCALAR AND VECTOR MESONS. II, by A. Salam and R. Delbourgo. [1964] [30]p. incl. diagrs. refs. (AFOSR-65-0118) (AF EOAR-62-87) AD 455797
Unclassified

Also published in Phys. Rev., v. 135: B1398-B1427, Sept. 21, 1964.

The gauge technique for solving field theories is applied to scalar and vector electrodynamics. It is shown that for scalar electrodynamics there is no $\lambda \varphi^{*2}\varphi^2$ infinity in the theory, while the conventional subtractions vector electrodynamics is completely finite. The essential ideas of the gauge technique are explained and a preliminary set of rules for finite computation in vector electrodynamics is established. (Contractor's abstract, modified)

1310

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

GAUGE THEORY OF ELEMENTARY INTERACTIONS, by A. Salam and J. C. Ward. [1964] [6]p. incl. table, refs. (AFOSR-65-0809) (AF EOAR-62-87)
AD 616059
Unclassified

Also published in Phys. Rev., v. 136: B763-B768, Nov. 9, 1964.

F and D couplings of baryons and mesons are shown to arise naturally with a sample extension of the gauge formalism to a $(SU_3 \times SU_3)_L \times (SU_3 \text{ s } SU_3)_R$ group structure. In its general formulation the theory needs parity doublets of (0+) and (0-) ninefolds. It admits of (2 types of F and D coupled) (1+) and (1-) vector and axial-vector meson multiplets, a specially attractive combination of currents which emerges from the formalism being an equal mixture of vector F with axial-vector D [the case of $(SU_3)_L \times (SU_3)_R$]. The

theory also admits an approximate (Bronzan-Low) type of quantum number. (Contractor's abstract)

1311

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

SU(6) AND CHARGE FORM FACTORS, by J. M. Charap and P. T. Matthews. [1964] [2]p. (AFOSR-65-0828) (AF EOAR-62-87) AD 616051
Unclassified

Also published in Phys. Ltrs., v. 13: 346-347, Dec. 15, 1964.

This note shows that it is possible to deduce relations between charge form factors using a generalization of U-spin and that the electric charge form factor of the neutron is zero. The SU(6) group, containing the subgroup SU(3) $\otimes$ SU(2)$_U$, is studied and related to baryon magnetic moments. (Contractor's abstract)

1312

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

PRACTICAL THEORY OF THREE-PARTICLE STATES. I. NONRELATIVISTIC, by C. Lovelace. [1964] [25]p. incl. diagr. refs. (AFOSR-65-0462) (AF EOAR-64-46) AD 614493
Unclassified

Also published in Phys. Rev., v. 135: B1225-B1249, Sept. 7, 1964.

A practical theory of 3-particle states is derived in which each of the 2-particle subsystems is assumed to be dominated by a finite number of bound states and resonances. Two sets of equations are then obtained. One expresses processes with 3 final particles in terms unstable-particle scattering; it generalizes and justifies the isobar model. The other is a set of coupled Lippmann-Schwinger equations for the scattering of bound states and unstable particles. The potentials in these scattering equations for composite particles are nonlocal and energy-dependent, and become complex above the 3-particle threshold. They are expressed in terms of the wave functions of the 2-particle bound states and resonances; there are no new arbitrary constants. The solution satisfies 3-particle unitarity. Unstable particles are not approximated by stable ones. The theory applies particularly to "overlapping" final-state interactions. The equations are given in detail for the 3N and N$\pi\pi$ systems in the static limit. In the latter case, the nucleon is treated as an Nπ bound state. (Contractor's abstract, modified)

1313

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

ELECTROMAGNETIC AND WEAK INTERACTIONS, by

A. Salam and J. C. Ward. [1964] [4]p. incl. refs. (AFOSR-65-0825) (AF EOAR-64-46) AD 616050
Unclassified

Also published in Phys. Ltrs., v. 13: 168-171, Nov. 15, 1964.

In this note a synthesis is attempted between electro-magnetism and weak interactions. No explanation is offered for the large boson mass value which results from one of the major differences between the two—that electromagnetic coupling strength is vastly differ-ent from the weak. Rather a synthesis is sought in terms of a group structure such that the remaining differences—contrasting space-time behavior and con-trasting ΔS and ΔI behaviors—appear as aspects of the same fundamental symmetry. Both leptons and hadrons are tested.

1314

London U. [Inst. of Laryngology and Otology] (Gt. Brit.).

THE STUDY OF THE MECHANISM OF TRANSFORMA-TION OF PHYSICAL ENERGY INTO NERVE ACTIVITY IN THE INTERNAL EAR, by F. C. Ormerod. Final technical rept. Feb. 1963, 7p. (AFOSR-4862) (AF EOAR-62-2) AD 413764   Unclassified

Study of the structure of the cochlea of a number of small mammals revealed, in certain species of bats and of rodents, a number of variations which appear to be related to the somewhat unusual sound frequencies which they are able to detect, and which are not found in the ears of the majority of mammals. Serial sec-tions of larynxes of many species of bats have shown notable modifications—massive intrinsic and extrinsic musculature, large arytenoid cartilages and very slender vocal cords—concerned with production of very high frequency sounds. Further work was done on various aspects of beat-note hypothesis in echoloca-tion. Sonograph analysis of tape recordings of call signals of bats and other animals was made and studied. Suggestion that cavities of skull act as resonant filters was confirmed by constructing models and obtaining identical responses.

1315

London U. [Inst. of Laryngology and Otology] (Gt. Brit.).

EQUIPMENT FOR DETECTING ANIMAL ULTRA-SOUND, by J. D. Pye and M. Flinn. [1964] [6]p. (AFOSR-64-1168) (AF EOAR-63-30) AD 442787
Unclassified

Also published in Ultrasonics, v. 2: 23-28, Jan.-Mar. 1964.

The study of bioacoustics now includes many instances in which ultrasound is generated but can only be de-tected by the use of special equipment. In aerial en-counters between bats and the insect that form their prey both participants use acoustical mechanisms

which operate at 20-150 kc/s. More widespread observa-tions of these phenomena are desirable and this article shows that the basic equipment is neither difficult nor expensive to acquire. Simple microphones and tuned detector/analyzers are described, as well as the more elaborate techniques used for detailed analyses.

1316

London U. Inst. of Laryngology and Otology (Gt. Brit.).

ENERGY TRANSFORMATION WITHIN THE INNER EAR, by D. F. N. Harrison. Final technical rept. July 1964 [6]p. (AFOSR-65-0040) (AF EOAR-63-30) AD 610567
Unclassified

Processing and interpretation of material collected in the West Indies and Great Britain, with a view to correlating structure with function, has been continued. Main emphasis has been placed on cochlea of Chiroptera and Rodentia with analysis of larynges. Sonographic analysis of tape recordings from these species has enabled theories of echolocation to be tested. New apparatus and techniques have been developed for this purpose. (Contractor's abstract)

1317

London U. Inst. of Laryngology and Otology (Gt. Brit.).

SIMPLE ELECTRONIC STROBOSCOPE. USE OF TWO FLASH-TUBES FOR MULTIPLE EXPOSURE PHOTOG-RAPHY, by J. D. Pye. [1964] [4]p. incl. illus. diagrs. (AFOSR-65-0310) (AF EOAR-64-47) AD 612519
Unclassified

Also published in Wireless World, v. 70: 339-342, July 1964.

A description is given of the circuitry and operating principles of the stroboscope.

1318

London U. Queen Mary Coll. (Gt. Brit.).

SYNTHESIS OF CITRULLINE AND ARGININE IN CHLORELLA PYRENOIDOSA, by R. G. Hiller. [1964] [6]p. incl. tables, refs. (AFOSR-65-0953) (AF 61(052)-245) AD 617205   Unclassified

Also published in Jour. Exper. Botany, v. 15: 15-20, Feb. 1964.

The distribution of radioactivity in Chlorella during dark $^{14}CO_2$ fixation was investigated either (1) in normal cells with and without added NH_4Cl, or (2) in nitrogen-starved cells supplied with intermediates of the Krebs-Henseleit urea cycle. In the control experiments almost all the activity was present in compounds of or associ-ated with, the tricarboxylic acid cycle. The amino-acids citrulline and arginine became radioactive only in the presence of ammonia or ornithine where initially

they comprised 40 to 60% of the total activity, reactions of the Krebs-Henseleit urea cycle being implicated in their formation. No evidence could be found for a complete urea cycle. Unidentified compounds deriving their radioactivity from the C_6 carbon of citrulline and/or arginine were detected and formed up to 40% of the total $^{14}CO_2$ incorporated after 25 min. (Contractor's abstract)

1319

London U. Queen Mary Coll. (Gt. Brit.).

CARBOXYLATION MECHANISMS IN PHOTOSYN-
THESIS, by M. Bermingham and C. P. Whittingham.
Final technical rept. Oct. 1, 1962-Sept. 30, 1963.
Oct. 1963, 17p. (AFOSR-J1375) (AF EOAR-62-24)
AD 429263   Unclassified

The production of glycollate and other compounds from specifically labelled glucose is dependent on the partial pressure of carbon dioxide. The distribution of radio-activity in sucrose and glycollate is altered by INH. The labelling pattern of this glycollate shows little randomization.

1320

London U. Queen Mary Coll. (Gt. Brit.).

THE PHOTOMETABOLISM OF GLUCOSE IN
CHLORELLA, by C. P. Whittingham, M. Bermingham,
and R. G. Hiller. [1963] [6]p. incl. diagrs. tables,
refs. (AFOSR-65-0946) (AF EOAR-62-24)
AD 617823   Unclassified

Also published in Zeitschr. Naturforsch., v. 18: 701-706, 1963.

Uniformly labeled radioactive glucose was fed to Chlorella cells in the presence of non-radioactive carbon dioxide. The concentration of carbon dioxide was varied and the distribution of radioactivity determined in the light. At low concentrations of carbon dioxide much of the radioactivity appeared in glycollate or derivatives therefrom. By contrast, at higher concentrations of carbon dioxide, most of the radioactivity appeared in sucrose. If the concentration of oxygen was increased above that normally present in air, there was relatively more activity in glycollate. The effect of the addition of isoniazid in these conditions was also investigated. It was concluded that glucose fed to Chlorella exogenously is metabolized in the light in Chlorella via sugar phosphate intermediates of the Calvin cycle. (Contractor's abstract)

1321

London U. Queen Mary Coll. (Gt. Brit.).

THE SYNTHESIS OF AMINO-ACIDS IN CHLORELLA
IN LIGHT AND DARK, by R. G. Hiller and C. P.
Whittingham. [1964] [8]p. incl. diagrs. tables.
(AFOSR-65-0947) (AF EOAR-62-24) AD 617637
                                Unclassified

Also published in Jour. Exper. Botany, v. 15: 21-28, Feb. 1964.

Experiments with Chlorella show that glycine and serine both become radioactive during photosynthetic incorporation of radioactive carbon dioxide. By contrast, when radioactive glucose is fed to Chlorella in the dark, alanine, glutamate, and aspartate are the major products. These are not produced in significant amount during photosynthesis at low concentrations of carbon dioxide but their formation may be stimulated by the addition of ammonium ions. (Contractor's abstract)

1322

London U. Queen Mary Coll. (Gt. Brit.).

STUDIES WITH FLASH ILLUMINATION ON THE
ENHANCEMENT EFFECT IN CHLOROPLASTS, by C.
P. Whittingham and P. M. Bishop. [1963] [10]p. incl.
diagrs. refs. (AFOSR-65-0948) (AF EOAR-62-24)
AD 617810   Unclassified

Also published in NAS-NRC Symposium on Photosyn-
thesis Mechanisms in Green Plants, Publication no.
1145, 1963, p. 371-380.

The effect of light flashes at 4°C on chloroplasts iso-
lated from spinach leaves was investigated, using
different oxidant systems. These light flashes consisted
of: (1) a single short flash; (2) pre-excitation by a short
flash followed by a long flash; (3) monochromatic flash
illumination with monochromatic continuous background
light; and (4) flash illumination following continuous
background illumination.

1323

London U. Queen Mary Coll. (Gt. Brit.).

THE ISONICOTINYL HYDRAZINDE AS A METABOLIC
INHIBITOR IN PHOTOSYNTHESIS, by C. P.
Whittingham, M. Bermingham and others. [1963] [8]p.
incl. diagrs. table. (AFOSR-65-0949) (AF EOAR-62-
24) AD 617868   Unclassified

Also published in Colloq. Internationaux Centre National
de la Recherche Scientifique, Gif-sur-Yvette et Saclay,
Paris (France) (July 23-27, 1962), Paris, CRNS, 1963,
p. 571-588.

The photosynthetic production of glycollic acid in
Chlorella was shown to be at a maximum at a low con-
centration of carbon dioxide and at light intensities
approaching those required to saturate photosynthesis.
Treatment with isonicotinyl hydrazide resulted in a 3-
fold stimulation of glycollic acid production. Studies
with radioactive carbon dioxide show that glycine and
serine were formed together with glycollate. When the
radioactive carbon dioxide was replaced by non-radio-
active carbon dioxide the compounds of the Calvin cycle
lost radioactivity which was accumulated in either
glycollate or sucrose suggesting that these were final
products of the photosynthetic cycle. At higher con-
centrations of carbon dioxide sucrose is the main and

predominant product but at low concentration of carbon dioxide a significant fraction of the carbon incorporated forms glycollate, clycine and serine. From the experiments with isonicotinyl hydrazide it would appear that as much as 70% of the carbon incorporated can result in glyoxylate and products therefrom. It is considered that these are derived by cleavage of the compound in the Calvin cycle which is carboxylated to a greater and greater extent the higher the concentration of carbon dioxide. (Contractor's abstract)

1324

[London U.] Queen Mary Coll. (Gt. Brit.).

THE PRODUCTION OF GLYCOLLATE DURING PHOTO-SYNTHESIS, by C. P. Whittingham, R. G. Hiller, and M. Bermingham. [1963] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0950) (AF EOAR-62-24) AD 617639
Unclassified

Also published in NAS-NRC Symposium on Photosynthesis Mechanisms in Green Plants, Publication no. 1145, 1963, p. 675-683.

The products of photosynthesis in Chlorella have been investigated over a range of concentrations of CO_2 above and below that in air. At low CO_2 concentrations, a large fraction of CO_2 fixed in photosynthesis is converted to glycolic acid, and to the amino acids glycine and serine. As the CO_2 concentration increases, the production of glycolic acid and glycine decreases and sucrose becomes the major product. Other compounds, e.g., alanine, malic and aspartic acids, are not markedly affected by changing the CO_2 concentration within the range studied, and represent a relatively small fraction of the total carbon fixed.

1325

[London U. Queen Mary Coll.] (Gt. Brit.)

PHOTOSYNTHETIC MECHANISMS UNDER SUB-OPTIMAL CONDITIONS, by C. P. Whittingham. Final scientific rept. Oct. 21, 1964 [18]p. incl. tables. (AFOSR-65-0056) (AF EOAR-64-1) AD 610161
Unclassified

Sucrose produced by photosynthesis in Chlorella was degraded under conditions when glycollate production is significant. Radioactivity was supplied from glucose. No correlation was observed between labelling pattern in sucrose and glycollate production.

1326

London U. King's Coll. (Gt. Brit.).

INFLUENCE OF IONIC SOLUTES UPON RELAXATION TIME, by V. Gold. July 1964, 92p. incl. diagrs. tables, refs. (AFOSR-64-1605) (AF 61(052)458) AD 605723
Unclassified

Spin-lattice relaxation times were measured by the 'direct' nmr method for dilute aqueous solutions of Ni(II) in presence of cyanide, halide, acetone, t-butyl alcohol, trimethyl phosphate, edta and trien, for some

of these solutes in the absence of paramagnetic ions. Spin-spin relaxation times were used to measure the influence of hydrogen ions on complex formation between water and acetaldehyde or pyruvic acid. Complex formation between methanol and other solvents through hydrogen-bonding was investigated by measurements of chemical shifts, the influecne of methoxide ions on multiplet collapse, and indicator measurements. (Contractor's abstract, modified)

1327

London U. Coll. (Gt. Brit.).

DECISION-MAKING, by R. J. Audley. [1964] [5]p. incl. diagrs. table, refs. (AFOSR-64-1382) (AF EOAR-62-69) AD 444460
Unclassified

Also published in Brit. Med. Bull., v. 20: 27-31, 1964.

This report contains theories about making rational decisions; Natural decision processes: Decision time, Vicarious trial and error (VTE) behavior, Effort, Confidence; The expanded judgement task and Psychological differences between logically similar decisions.

1328

London U. Coll. (Gt. Brit.).

RESPONSE INSTRUCTIONS AND THE SPEED OF RELATIVE JUDGEMENTS. I. SOME EXPERIMENTS ON BRIGHTNESS DISCRIMINATION, by R. J. Audley and C. P. Wallis. [1964] [15]p. incl. diagrs. tables, refs. (AFOSR-64-1383) (AF EOAR-62-69) AD 444463
Unclassified

Also published in Brit. Jour. Psychol., v. 55: 59-73, 1964.

It is hypothesized that the speed with which a relative judgement is made between two stimuli on any given dimension depends upon the relation between the general position of the stimuli on the dimension and the direction of the required judgement along this. Experiments involving the discrimination of light patches of different luminance are reported which support this hypothesis. They show that subjects are quicker at choosing the brighter than the darker of two relatively intense stimuli but quicker at choosing the darker of two relatively dark stimuli. A provisional explanation of the phenomenon in terms of a response competition theory of choice behavior is offered. Some alternative hypotheses are considered and analogies are made with other psychological phenomena. It is concluded that this is a judgemental phenomenon of some considerable generality. (Contractor's abstract)

1329

London U. Coll. (Gt. Brit.).

RESPONSE INSTRUCTIONS AND THE SPEED OF

RELATIVE JUDGEMENTS. II. PITCH DISCRIMINA-
TION, by C. P. Wallis and R. J. Audley. [1964] [12]p.
incl. diagrs. refs. (AFOSR-65-0293) (AF EOAR-62-
69) AD 611459   Unclassified

Also published in Brit. Jour. Psychol., v. 55: 121-
132, 1964.

Subjects were required to make easy pitch discrimina-
tions at four frequency levels. In a counter-balanced
design, for half their judgements they were required to
choose the higher of the pair of tones, and for the other
half, the lower. It was found that subjects were quicker
at choosing the higher than the lower of two high tones,
but quicker at choosing the lower than the higher of two
low tones. This 'cross-over' effect was found to be
graded across the stimulus levels intermediate in the
series, the intersection point being somewhat below the
geometric mean of the series of frequencies used.
While latencies tended to decrease during the course of
an individual session, the cross-over effect was con-
sistently observable in an analysis that controlled for
such practice effects. Whether the tone responded to
was the first or the second of the pair discriminated
was found to be a significant variable. The 'cross-over'
phenomenon was only consistently effective when the
second tone was chosen. Linking these findings to
similar phenomena previously demonstrated in bright-
ness discrimination, theoretical suggestions are ad-
vanced which are relevant to all judgemental processes.
(Contractor's abstract)

1330

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

[ANATOMICAL LOCALIZATION OF TARGET
LEARNING AND MEMORY] Final rept. June 1963-
1964, 12p. (AFOSR-64-1442) (AF EOAR-63-2)
AD 604472   Unclassified

Work done on the memory system of the octopus is re-
ported. Aspects considered include: analysis of the
functions of the pairs of centers concerned with the
signals of results; effects of hunger and taste of food;
comparison of effects of removing vertical and median
superior frontal lobes; electron-microscopy of the lobes;
connections with the tactile memory system; the mech-
anism of poisoning, eating and digestion; effects of
large amounts of food on behavior; conduction velocities
of nerve fibers of different diameters; effect of lesions
in the dorsal basal lobe; function of the peduncle lobe;
delayed responses and short term memory; and com-
parison with other animals.

1331

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

THE GENERAL AMPLIFICATION FUNCTION OF THE
VERTICAL LOBE IN OCTOPUS VULGARIS, by H.
Maldonado. [1963] [15]p. (AFOSR-64-1683) (AF
EOAR-63-2) AD 448258   Unclassified

Also published in Zeitschr. vergleich. Physiol.,
v. 47: 215-229, 1963.

The function of the vertical lobe of Octopus was investi-
gated by measurement of the time taken to attack before
and after its removal. After operation there was little
change in the proportion of attacks but the method
allowed the determination of an index showing that the
time of attack and the variance of this time were greatly
increased after vertical lobe removal. There was no
such increase following dummy operations or removal
of less than 25% of the lobe. The index did not fall to
the level seen at the beginning of positive training.
Some of the effects of training therefore survive the
operation. It is suggested that what is lacking following
removal is an amplification of the output of the optic lobe
system constituting the empirical parameter of the
command to attack. With re-training after operation
the index rises again but seldom reaches its value be-
fore operation. The recovery after operation was not
correlated with the amount of vertical lobe remaining,
but with the initial rate of learning of the animal.

1332

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

THE POSITIVE LEARNING PROCESS IN OCTOPUS
VULGARIS, by H. Maldonado. [1963] [24]p. (AFOSR-
64-1684) (AF EOAR-63-2) AD 447593   Unclassified

Also published in Zeitschr. vergleich. Physiol.,
v. 47: 191-214, 1963.

When an octopus is faced repeatedly with the situation
crab-attacked-to-a-bar there are progressive changes
in the characteristics of the attacks. The total time to
attack decreases and also the variation between times
for attacks. The reduction in time is due partly to re-
duction in the time of construction of the command be-
fore the animal emerges from the home. There is also
an elimination of the slow initial part of the attacks that
is at first present. There is little change in the dura-
tion or speed of the final dash by which the prey is
captured. The stage of learning reached is a function
of the number of occasions of training and not of the
number of days in the tank. Days without food distort
the learning curve but do not accelerate its progress.
The changes in line of attack are thus the expression of
a positive learning process and not simply of acclimatiz-
ation to the new environment.

1333

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

THE CONTROL OF ATTACK BY OCTOPUS, by H.
Maldonado. [1964] [19]p. (AFOSR-64-1685) (AF EOAR-
63-2) AD 447595   Unclassified

The attack by an octopus on a crab may be divided into
three periods, the first and second time-delays and the
final pattern of acceleration. During this final jump
there are no periods of constant or nearly constant
acceleration or of zero acceleration. The acceleration
phase is generally longer than that of deceleration.
There was an indispensable minimum period of illumin-
ation below which no attack occurred. If the octopus
has viewed the crab for a time in excess of the first and

second time-delays before the ltght ts swltched off tt
will make an attack whose ftnal pattern of acceleration
does not differ from that of an attack when there ts
tllumtnation throughout. Since durtng the ftnal pattern
of acceleratton the attack ts not dependent on continuous
estimates of the distance from the goal there must be
an tnternal mechantsm that produces a program of
forces before the ftnal pattern of accleration begins.
Durtng the early stages of learntng to attack tn a par-
ticular situation the sequence of forces ts often wrongly
programmed and mtstaken attacks occur.

1334

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

DELAYED RESPONSES IN OCTOPUS, by P. N. Dilly.
[1963] [9]p. (AFOSR-64-1686) (AF EOAR-63-2)
AD 447594   Unclassified

Also publtshed tn Jour. Exper. Biol., v. 40: 393-401,
June 1963.

Octopuses were tested for their ability to perform
delayed responses after varying delays and brain
lestons. Octopuses delayed for 10 sec were capable
of accurate performance without training. In order to
make a correct response after 20 or 30 sec delays,
some 'learntng' is needed. Antmals wtthout vertical
lobes or without median superior frontal lobes delayed
for 30 sec responded correctly. The majority of cor-
rect attacks were 'swimming attacks' in which the
naimal swam through the water without contacting the
walls of the tank. Shaking up the animals and disturbing
them so that any ortentating contact between the octopus
and the door and sides of the tank was destroyed, did
not decrease the accuracy of the response. The time
taken for the response tn these experiments was sltghtly
increased.

1335

London U. Coll. [Dept. of Anatomy] (Gt. Brtt.).

ELECTRON MICROSCOPY OF OPTIC NERVES AND
OPTIC LOBES OF OCTOPUS AND ELEDONE, by P.
N. Dilly, E. G. Gray, and J. Z. Young. [1963] [11]p.
(AFOSR-64-1687) (AF EOAR-63-2) AD 447596
                                    Unclassified

Also publtshed in Proc. Roy. Soc. (London), v. 158B:
446-456, 1963.

Each optic nerve contatns several bundles of axons.
The axons have their surface membranes dtrectly
apposed and the bundles lte 'n troughs of the elongated
Schwann cells. The axons have pronounced vartcosities
along their length. The axons enter the optic lobe and
run between the granule cells to synapse tn the plexi-
form one. The granule cells are small neurons.
Thctr cytoplasmtc organelles tnclude endoplasmtc
reticulum, rtbosomes, a granular reticulum and of
spectal tnterest, oval or spherical bodies wtth a lamel-
lated cortex and granular medulla. The elongated
vartcose presynaptic bags of the optic axons contatn

mttochondria tn the proximal regton, numerous synaptic
vestcles and, sometimes, neurofilaments. Below the
mttochondrial zone, synaptic contacts are made with
small sptnes tnvaginated into the bags.

1336

London U. Coll. [Dept. of Anatomy] (Gt. Brtt.).

PAIRED CENTRES FOR THE CONTROL OF ATTACK
BY OCTOPUS, by J. Z. Young. [1964] [24]p. (AFOSR-
64-1689) (AF EOAR-63-2) AD 447701   Unclassified

Also publtshed in Proc. Roy. Soc. (London), v. 159B:
565-588, 1964.

The vertical lobe system tn Octopus ts concerned tn the
regulation of the tendency to attack. It receives tmpulses
from the optic lobes, from touch and chemoreceptors
and from patn receptors. The visual part of the system
is organized into lower and upper loops. The lower loop
leads from the opttc lobes, though two centers and back
to the optic lobes. The upper loop also consists of two
centers, superposed in parallel above the lower ones.
Each of the two loops contains two centers in series and
tt is suggested that the first center of each pair tends to
promote attack and the second to restratn or prevent tt.
The net effect of two centers of each pair together ts to
increase the probability of attack, unless pain tnter-
venes.

1337

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

THE VISUAL ATTACK LEARNING SYSTEM IN
OCTOPUS VULGARIS, by H. Maldonado. [1963] [19]p.
incl. diagrs. refs. (AFOSR-64-1690) (AF EOAR-63-2)
AD 447703   Unclassifted

Also publtshed in Jour. Theoret. Btol., v. 5: 470-488,
1963.

A model representattve of the visual attack learntng
system in Octopus vulgaris is presented, tn which each
block stands for a functional untt and the connections
between blocks tndtcate the causal process in terms of
flow of tnformation. It ts posstble to identify some of
these blocks with dtsttnct lobes of the octopus brain.
The basic assumption of the model is that when an ob-
ject ts shown to the octopus, which ts rewardel (or
puntshed) if it catches it, the animal links the reward
or punishment not with an 'object' as such but wtth some
outstanding properttes of tt, encoded by a classtiying
system. The elements of thts 'classiiytng system' are
called the classifying untts (C. U. s.). Each C. U. has
a dtscrete scalar output and tt ts assumed there is a
separate C. U. for each set of mutually exclustve
propertties.

1338

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

STUDIES ON THE RECEPTORS IN THE CEREBRAL
VESICLE OF THE ASCIDIAN TADPOLE. 2. THE
OCELLUS, by N. Dilly. [1964] [8]p. (AFOSR-64-
1704) (AF EOAR-63-2) AD 448278   Unclassified

Also published in Quart. Jour. Micros. Sci., v. 105:
13-20, 1964.

Electron microscope observations of the photoreceptor
of the tadpole larva of Ciona intestinalis show the ocel-
lus to consist of about 10 cells. It is made up of 3 parts:
a pigment cup, a lens system, and a retina. A single
cup-shaped cell filled with membrane-bound pigment
granules lies between the lens and the retinal cells.
Part of the lens cell is contained within its concavity.
The pigment granules are arranged to keep stray light
from falling upon the photoreceptor endings. The lens
system has 3 lens vesicles arranged in a line along the
main axis of the pigment cup cell. The retinal cells
lie above the dorsal arm of the pigment cup cell, and
have tubular processes that pass through it to end as
piles of membranes closely applied to the lens cell.
Morphologically the photoreceptor units of the ascidian
tadpole closely resemble the visual cells of the verte-
brates.

1339

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

INTERFERENCE IN LEARNING AND LESIONS IN THE
VISUAL SYSTEM OF OCTOPUS VULGARIS, by J. R.
Parriss. [1963] [13]p. (AFOSR-64-1712) (AF EOAR-
63-2) AD 448263   Unclassified

Also published in Behaviour, v. 21: 233-245, 1963.

Two groups of Octopuses, one normal and one with
lesions in the optic lobe system, were trained on a dis-
crimination between horizontal and vertical rectangles
followed by a discrimination with a square and a dia-
mond. They were then retrained on the original hori-
zontal and vertical discrimination. A further group of
normal animals were trained on a discrimination be-
tween the square and the diamond followed by a dis-
crimination with the horizontal and vertical rectangles.
They were then retrained on the original square and
diamond discrimination. Results of the investigation
are presented.

1340

London U. Coll. Dept. of Anatomy (Gt. Brit.).

FORCES EXERTED BY OCTOPUS VULGARIS, by N.
Dilly, M. Nixon, and A. Packard. [1964] [12]p. incl.
diagrs. tables. (AFOSR-65-2840) (AF EOAR-63-2)
AD 627552   Unclassified

Also published in Pubbl. Staz. Zool. Napoli, v. 34:
86-97, 1964.

Measurements were made of the maximum pulling forces
of octopuses and compared with their body weights.
An increase in the maximal pulling force was found to
be 2.0 kg/0.10 kg body weight up to 0.50 kg above which
the force increased less rapidly with body weight. Two
observations were made on the ability of octopuses to
push (lift) heavy objects. The forces were found to be
approximately half of those in the pulling experiments.
Maintained pulls were observed and found to be never
more than 50% of the value obtained in maximal pulls by
the same animal. Pulls made during swimming were
measured in some octopuses and were found to be simi-
lar in all of the animals although of wide differences in
weight. The arms: body weight ratios were measured
and given as a percentage of the total body weight.
(Contractor's abstract)

1341

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

THE REARRANGEMENT OF AROMATIC N-NITRO-
AMINES. PART III. THE ACID-CATALYSED RE-
ARRANGEMENT OF N-NITROANILINE, by D. V.
Banthorpe, E. D. Hughes, and D. L. H. Williams.
[1964] [13]p. incl. diagrs. tables, refs. (AFOSR-65-
0516) (AF 61(052)66) AD 614215   Unclassified

Also published in Jour. Chem. Soc. (London), Dec.
1964, p. 5349-5361.

Kinetic, product, and tracer studies have been made of
the acid-catalyzed rearrangement of isotopically normal
and H^2-labelled N-nitro to o- and p-nitroaniline over a
wide range of acidity. The results are consistent with
an intramolecular mechanism involving isomerization
to an N-nitrite and migration to the para-position by
way of an ortho-linked C-nitrite. Other mechanisms
are discussed.

1342

London U. Coll. [Dept. of Physics] (Gt. Brit.).

DETERMINATION OF PION-NUCLEON PARAMETERS
AND PHASE SHIFTS BY DISPERSION RELATIONS, by
J. Hamilton. Jan. 1963, 120p. (Technical note no. 11)
(AFOSR-4744) (AF EOAR-63-3) AD 407610
                                          Unclassified

An account is given of the use of dispersion relations
to determine the parameters of low energy pion-nucleon
physics (F^2, the s- and p-wave scattering lengths and
certain other constants) and the determination of the s-
and p-wave phase shifts up to a few hundred mev.

1343

London U. Coll. [Dept. of Physics] (Gt. Brit.).

REMOVAL OF THE DIVERGENCE IN ZERO MOMEN-
TUM TRANSFER DISPER.ION RELATIONS, by D.
Atkinson. Apr. 30, 1963, 21p. (Technical note no. 12)
(AFOSR-4922) (AF EOAR-63-3) AD 414039
                                          Unclassified

A conformal mapping of the scattering cosine of an elastic scattering process is used to remove a divergence caused by crossed channel singularities. A numerical application to $\pi N - \pi N$ forward dispersion relations is considered.

1344

London U. Coll. [Dept. of Physics] (Gt. Brit.).

UNITARITY AND ANALYTICITY IN COMPLEX ENERGY PLANE OF GENERAL SCATTERING AMPLITUDES, by N. S. Kronfit. July 4, 1963, 18p. (Technical note no. 14) (AFOSR-5 86) (AF EOAR-63-3) AD 417149   Unclassified

Analytic properties of general scattering amplitudes are considered under the assumption of analyticity in channel energy plane and using unitarity, similar behavior is done for Feynman amplitudes.

1345

London U. Coll. Dept. of Physics (Gt. Brit.).

DISPERSION RELATIONS IN HIGH ENERGY PHYSICS, by J. Hamilton. Final rept. Oct. 31, 1964, 4p. incl. refs. (AFOSR-65-0514) (AF EOAR-63-3)
                                                Unclassified

Theoretical studies have been made of the pion-nucleon system, the pion-pion system and the nucleon isovector form factor, by means of the dispersion relation technique. A detailed phase shift analysis of the pion-nucleon scattering data up to 700 mev pion has been made.

1346

Los Angeles State Coll. [Dept. of Chemistry] Calif.

CHEMICAL EFFECTS OF ULTRASONIC WAVES, by D. L. Currell, S. Nagy, and G. Wilhetm. Final rept. Sept. 1, 1963, 1v. (AFOSR-J1075) (AF 49(638)471) AD 420052   Unclassified

The effect of pH and dissolved gases on the ultrasonic reaction of aqueous solutions of phenol and of pyridine to produce acetylene has been investigated. Phenol in alkaline solution and pyridine in acid solution are essentially unaffected by ultrasonic waves. The rate of production of acetylene is dependent upon the ratio of specific heats of the dissolved gases. The rate of the ultrasonic cleavage of the pyridine ring was shown to be independent of the surface tension of the reaction solution. The significance of these results is discussed in terms of possible mechanisms for the chemical effect of ultrasonic waves.

1347

Louisiana State U., Baton Rouge.

REPRESENTATIONS OF DERIVATIVES OF ANALYTIC

FUNCTIONS BY A MULTI-DIMENSIONAL TYPE OF LA PLACE TRANSFORMS, by P. Porcelli. [1964] [4]p. (AFOSR-65-2180) (AF AFOSR-63-68) AD 627945   Unclassified

Also published in Proc. Louisiana Acad. Sci., v. 27: 110-113, Dec. 1964.

The purpose of this note is to develop a representation theory for the derivatives of analytic functions that are the La Place transforms of square summable functions on $(0, \infty)$. The proof of the representation theorem is presented in the form of two lemmas and it involves the solvability of certain infinite systems of linear equations in the countably infinite dimensional Hilbert space. Briefly, the first lemma shows that the definition of the analytic function implies one infinite system is solvable and the necessary condition for this system to have a solution is also a sufficient condition for a second infinite system to have a solution. The second lemma shows that the solution of the second infinite system can be extended to give a representation for the derivative of the analytic function in question. The interest in representation theorems of the type presented stems from the fact that they are related to problems in approximation theory and to the distribution of zeros of the successive derivatives of certain types of analytic functions.

1348

Louisiana State U., Baton Rouge.

INTERPOLATION AND APPROXIMATION WITH RATIONAL FUNCTIONS, by P. Porcelli. [1964] [8]p. (AFOSR-65-2181) (AF AFOSR-63-68) AD 628397
                                                Unclassified

Also published in Proc. Louisiana Acad. Sci., v. 27: 118-125, Dec. 1964.

Interpolation methods are studied that arise out of the problem of uniformly approximating a continuous function with certain types of rational functions. Specifically, the author is interested in learning the nature of approximating an arbitrary continuous function on bounded subsets of a set of real numbers by linear forms.

1349

[Louvain U.] (Belgium).

A CRYOSTAT FOR TEMPERATURES BETWEEN 14 AND 300°K, ADAPTABLE FOR EXPERIMENTS AT HIGH PRESSURE, by A. Van Itterbeek, O. Verbeke and others. [1964] [4]p. incl. diagrs. tables. (AFOSR-64-1240) (AF EOAR-63-40) AD 442799   Unclassified

Also published in Cryogenics, Feb. 1964, p. 8-11.

This paper gives a description and design of a regulating system for use in the temperature range 14-300°K.

1350

Louvain U. Dept. of Applied Mechanics (Belgium).

DESIGNING EQUIVALENT LINKAGES BY SUCCESSIVE ADDITIONS AND SUBTRACTIONS OF REDUNDANT BARS, by F. Buckens. [1963] [6]p. incl. diagrs. (AFOSR-3117) (AF EOAR-62-107) AD 438555
Unclassified

Also published in Ingen. Arch., v. 32: 341-346, 1963.

It is shown that if the trajectory (absolute or relative) described by a point of a linkage can be duplicated by a different linkage (even when the difference is only geometrical), the parallel action of both mechanisms results in a redundant linkage, as far as the number of degrees of freedom is concerned. Admissible changes of the lengths of certain bars, or adequate removal of bars or hinges, while reducing this redundancy may lead to equivalent and sometimes more useful linkages. As an example, this principle may be applied to Hart's four-link inversor, which first duplicated, then simplified, leads either to Peaucellier's six-bar inversor, or to a more general and apparently new six-link inversor which also can be used as a pantograph.

1351

Louvain U. [Dept. of Applied Mechanics] (Belgium).

THE SIGNIFICANCE OF SINGULAR CONFIGURATIONS OF STRUCTURES FROM THE STRENGTH OF MATERIALS POINT OF VIEW, by F. Buckens. [1964] [10]p. incl. diagrs. (AFOSR-65-0618) (AF EOAR-62-107) AD 614541
Unclassified

Also published in Jour. Mecanique, v. 3: 499-508, Dec. 1964.

Simply connected structures, consisting of simple bars connecting multiple hinges, are considered. Furthermore external forces are assumed to act on these hinges. It is shown that when the configurations of the linkages are singular--that is, when there exist parasitic degrees of freedom for small deformations of the structure which do not change the lengths of the bars—the forces appearing in the bars become infinite when certain exceptional conditions are not satisfied by the external loading. (This assumes vanishingly small bar elongations). A necessary condition to avoid infinite forces when the configuration is singular, is the work performed by the external forces on the small parasitic deformation be null. This is also a sufficient condition when the structure is statistically determinate. (Contractor's abstract)

1352

Louvain U. Lab. for Inorganic [and Analytical] Chemistry (Belgium).

REACTION KINETICS IN FLAMES, by A. Van Tiggelen. Final technical rept. Feb. 1963, 30p. incl. diagr. tables, refs. (AFOSR-4594) (AF EOAR-62-65) AD 401390
Unclassified

Flame propagation velocities and temperatures have been measured in propylene-oxygen mixtures at different mixture strengths and varying dilutions with nitrogen. An activation energy of 40 kcal and a mean molecular weight of chain carriers can be derived from these measurements. The reaction mechanism is discussed, it points out the stability of the $C_3H_5\cdot$ radical. A comparative study is made of flames propagating in mixtures of nitrous oxide and CH_4, C_2H_6, C_3H_8, $n\text{-}C_4H_{10}$, $i\text{-}C_4H_{10}$, $C(CH_3)_4$, C_2H_4, C_2H_2, C_3H_6. The overall activation energy of the branching process has been calculated together with the mean molecular weight of the free radicals which are responsible for the propagation of the chain reaction. A reaction mechanism is proposed based on the formation of alkoxy radicals according to $R\cdot + N_2O \rightarrow RO\cdot + N_2$, followed by $RO\cdot + RH \rightarrow ROH + R\cdot$. (Contractor's abstract)

1353

Louvain U. Lab. for Inorganic [and Analytical] Chemistry (Belgium).

KINETICAL STUDY OF HYDROCARBON-NITROUS OXIDE FLAMES, by J. D'Olieslager and A. Van Tiggelen. [1964] [19]p. incl. diagrs. tables, refs. (AFOSR-64-1885) (AF ECAR-62-65) AD 449998
Unclassified

Also published in Bull. Soc. Chim. Belg., v. 73: 135-153, 1964.

A comparative kinetical study of flames burning in mixtures of nitrous oxide and different hydrocarbons was made. The mean molecular weight of the chain carriers changes with the nature of the fuel. A probable reaction mechanism requests the formation of alkoxy radicals which decompose more or less easily according to their structure. Concerning the apparent activation energy derived from burning velocities at different degrees of dilution with nitrogen, no systematic change with the nature of the fuel was observed.

1354

Louvain U. Lab. for Inorganic [and Analytical] Chemistry, (Belgium).

CONSIDERATIONS ON THE THEORETICAL EXISTENCE OF FUNDAMENTAL FLAMMABILITY LIMITS IN GASEOUS MIXTURES, by A. Van Tiggelen and J. Burger. [1964] [2]p. (AFOSR-65-1427) (AF EOAR-63-42) AD 622897
Unclassified

Also published in Combustion and Flame, v. 8: 343-344, Dec. 1964.

Flame (chain) propagation theory is employed as the basis for the derivation of a criterion which predicts flammability limits in gaseous mixtures and also the intrinsic condition for non-flammability.

1355

Lovelace Foundation for Medical Education and Research, Albuquerque, N. M.

A STUDY OF THE MECHANICS OF VENTILATION AND OF PULMONARY GAS EXCHANGE IN MAN DURING STRESS, by J. F. Muxworthy, Jr. and E. H. Roorbach. Final rept. June 1963, 66p. (AFOSR-5262) (AF AF-OSR-61-35) AD 416534   Unclassified

This study was undertaken to determine the changes in some of the mechanics of breathing due to the stress of certain conditions during surgery on man. The parameters studied were the changes in total, lung, and chest wall compliances under controlled ventilation and depth of anesthesia. The studies include the effects of surgical skin preparation, incision, total surgical stimuli, succinyl-choline, cough, lithotomy, tourniquet and deep hypothermia. A review of the literature is presented and compared to the present study. Two subjects with heart defects were studied while undergoing surgery at deep hypothermia from 10° to 18°C. As the chest was opened only the lung compliance could be measured. The lung compliance rose slightly during cooling, fell during cardiac arrest, and then gradually rose again so that by the time the body temperature was normal, the lung compliance was no lower than at the start of cooling.

1356

Lund U. Depts. of Histology and Zoology (Sweden).

SOME OBSERVATIONS OF ADRENERGIC CONNECTIONS BETWEEN MESENCEPHALON AND CEREBRAL HEMISPHERES, by A. Bertler, B. Falck and others. [1964] [7]p. incl. tables, refs. (AFOSR-65-0308) (AF EOAR-64-5) AD 612319   Unclassified

Also published in Acta Pharmacol. Toxicol., v. 21: 283-289, 1964.

The striatal dopamine in the rabbit brain is localized in axons at least partly originating from the ventral mesencephalon. A corresponding adrenergic pathway has been directly demonstrated in the pigeon brain. A large portion of the NA in the cerebral hemispheres and the diencephalon of the rabbit has been found to be derived from neurons coming from or passing through the mesencephalon. (Contractor's abstract)

1357

Lund U. Depts. of Histology [and Zoology] (Sweden).

ADRENERGIC NERVES TO THE EYE AND ITS ADNEXA IN RABBIT AND GUINEA-PIG, by B. Ehinger. [1964] [21]p. incl. illus. diagr. refs. (AFOSR-65-1296) (AF EOAR-64-5) AD 620600   Unclassified

Also published in Acta Univ. Lund., Section II, no. 20: 3-23, 1964.

The distribution of adrenergic nerves to orbital and ocular structures in rabbits and in guinea-pigs was

studied with the sensitive and specific fluorescence method developed by Falck. Considerable species differences were found, especially in the irido-corneal angle, which in rabbits contains few varicose adrenergic fibers (VAF), but in guinea-pigs many. In both species, VAF were found in the cornea, in the dilator and sphincter pupillae as well as in the iris stroma, at the ciliary epithelium, in the ciliary muscle, and in the chorioid. In the chorioid, distribution is densest in those parts that correspond to the areas of the retina that have the highest visual acuity. In rabbits, the vascular nerves in the iris have an unusual distribution throughout the inner part of the perivascular sheath; in some medium-sized vessels, they also reach the intimal layer. An adrenergic innervation of the smooth musculature outside the ocular bulb was found in the tarsal muscle, in the arrectores pilorum, and in that of the tarsal sebaceous glands. No VAF were found around the acini of the lacrimal gland or in the optic nerve. (Contractor's abstract)

1358

Lund U. Depts. of Histology [and Zoology] (Sweden).

NEW ASPECTS OF THE MAMMALIAN PINEAL GLAND. I. FUNCTIONAL SIGNIFICANCE OF FETAL PINEAL GLAND OF RAT. II. MONOAMINE STORES IN MAMMALIAN PINEAL GLAND, by C. Owman. [1964] [40]p. incl. refs. (AFOSR-65-2512) (AF EOAR-64-5) AD 627913   Unclassified

Also published in Acta Physiol. Scand., v. 63, Suppl. 240: 1-40, 1964.

The findings of the secretory activity of the pineal gland prenatally on one hand, and of the monamine stores in the pineal gland postnatally on the other, indicates the possibility of a two-fold functional significance of the pineal gland in one and the same animal during two different phases of life. Similar dual functions have been suggested to occur in the development of the pineal complex in lower vertebrates. Thus, in certain land-living anura the pineal complex is dominated by the frontal organ, probably exerting a photoreceptor function. In adult stages the frontal organ is reduced, while the eipphyseal portion shows up as a well-developed glandular structure. Similarly, the pineal organ of the newt undergoes a characteristic change in cytology, from highly differentiated photoreceptor-like cells during larval stages, into cells with morphologic signs of secretory activity culminating in adult stages. This conversion probably denotes a basic shift in function of the organ. (Contractor's abstract)

1359

Lund U. [Dept. of Pharmacology] (Sweden).

EFFECTS OF ACETYLCHOLINE ON THE MAMMALIAN MOTOR END-PLATE, by S. Thesleff. May 31, 1963, 5p. (AFOSR-5255) (AF EOAR-62-28) AD 416503   Unclassified

The parameters of transmitter release from mammalian motor nerve terminals have been evaluated by

electrophysiological techniques. The amount of trans-
mitter available for immediate release, the rate of
transmitter mobilization and synthesis have been calcu-
lated from the amplitude of successive series of end-
plate potentials.

1360

Lund U. [Dept. of Pharmacology] (Sweden).

RESTORATION OF FUNCTION IN BOTULINUM
PARALYSIS BY EXPERIMENTAL NERVE REGENERA-
TION, by S. Thesleff, J. Zelena, and W. W. Hofmann.
[1964] [2]p. (AFOSR-64-2160) (AF EOAR-63-12)
AD 452275   Unclassified

Also published in Proc. Soc. Exper. Biol. and Med.,
v. 116: 19-20, 1964.

Results are presented showing that it is possible to
restore neuromuscular transmission in botulinum
paralyzed rat skeletal muscle by inducing the formation
of new motor nerve terminals. The toxin, bound to the
original endings, does not interfere with the regenera-
tion following a crush of the motor nerve, and the new
terminals can establish effective neuromuscular trans-
mission after a few days. In muscles treated with the
toxin alone the paralysis lasts for several weeks.

1361

Lund U. [Dept. of Pharmacology] (Sweden).

INNERVATION OF BOTULINUM POISONED SKELETAL
MUSCLES BY ACCESSORY NERVES, by W. W.
Hofmann, S. Thesleff, and J. Zelena. [1964] [2]p.
(AFOSR-64-2168) (AF EOAR-63-12) AD 452473
                                              Unclassified

Presented at meeting of the Physiological Society,
Feb. 21-22, 1964.

Also published in Jour. Physiol. (London), v. 171:
27-28, 1964.

In a series of experiments C. botulinum toxin type A1
was applied locally to the gastrocnemius muscle of
adult rats. About 2 weeks later, when the paralysis
was maximal, the deep peroneal nerve, which normally
supplies the flexor group of the hind limb, was dissected
and implanted into the lateral head of the gastrocnemius
muscle. For control a similar operation was performed
on unpoisoned animals. After 1 month the mechanical
response of the gastrocnemius muscle to stimulation
of the tibial and peroneal nerves were recorded. All
the poisoned muscles responded with strong contractions
to stimulation of either of the two nerves. In un-
poisoned animals there was no significant response of
the gastrocnemius muscle to the stimulation of the im-
planted nerve.

1362

Lund U. Dept. of Pharmacology (Sweden).

AN ELECTROPHYSIOLOGICAL INVESTIGATION OF
NEUROMUSCULAR TRANSMISSION IN MYASTHENIA
GRAVIS, by D. Elmqvist, W. W. Hofmann and others.
[1964] [18]p. incl. illus. diagrs. tables, refs. (AFOSR-
65-1548) (AF EOAR-63-12) AD 623377 Unclassified

Also published in Jour. Physiol., v. 174: 417-434, 1964.

By the use of intracellular electrodes the neuromus-
cular transmission mechanism was studied in isolated
intercostal muscle obtained from patients with myas-
thenia gravis. With repetitive nerve stimulation at
frequencies above 2/sec, only the first few stimuli
elicited muscle contractions in most fibers and then
subthreshold end-plate potentials (epps), could be re-
corded. Miniature end-plate potentials (mepps) had a
mean amplitude 1/5 of the normal. The calculated size
of the quantal components of epps corresponded closely
to the mepp amplitude. Other observations made
appeared normal, i.e., resting frequency of mepps,
quantum content of epps, post-synaptic chemosensitivity
with ACh analogs, input resistance, and resting mem-
brane potential. It is tentatively concluded that in myas-
thenia gravis there is a deficiency in the amount of ACh
in the quanta of transmitter released from the motor
nerve terminals. (Contractor's abstract, modified)

1363

Lund U. Dept. of Physics (Sweden).

THE SPECTRUM OF VERY HEAVY NUCLEI IN
COSMIC RADIATION AND THE PASSAGE THROUGH
INTERSTELLAR MATTER, by K. Kristiansson. [1964]
[18]p. incl. diagrs. tables, refs. (AFOSR-64-0640)
(AF EOAR-62-71) AD 434847   Unclassified

Also published in Arkiv Fysik, v. 25: 513-530, 1964.

With the assumption that iron is the only very heavy
element in the cosmic ray source, calculations have
been performed of charge spectra of the nuclei in the
interval $21 \leq Z \leq 26$ as a function of the amount of
interstellar matter traversed and of the mean energy in
the collisions between the VH particles and the inter-
stellar nuclei. The comparison with the experimental
cosmic ray spectrum shows that the particles have
passed through 2-4 g matter at energies below about
500 mev/nucleon. The amount of matter which has been
passed at high energy is smaller. This distribution in-
volves some restrictions on the mechanism of accelera-
tion. (Contractor's abstract)

1364

Lund U. Dept. of Physics (Sweden).

THE USE OF THE MEAN BLOB LENGTH METHOD
FOR THE IDENTIFICATION OF HEAVY PRIMARIES
IN COSMIC RADIATION, by A. Stenman. [1964] [8]p.
incl. diagrs. tables, refs. (AFOSR-64-2051)
(AF EOAR-62-71) AD 452520   Unclassified

Also published in Arkiv Fysik, v. 27: 267-274, 1964.

The paper describes a study of the blob length method as a means of identifying relativistic heavy primaries in cosmic radiation. The measurements have been restricted to particles with well identified charges $Z \geq 6$. The standard deviation was found to be 1.0 unit of charge in the mean. The experimentally obtained relation between the blob coefficient and the square of the particle charge is given and discussed. The blob coefficient has also been studied as a function of the dip angle. (Contractor's abstract)

1365

Lund U. Dept. of Physics (Sweden).

ROCKET OBSERVATIONS OF SLOW HEAVY PRIMARY NUCLEI AT KRONOGÅRD, SWEDEN, by H. Yagoda, K. Fukui and others. [1964] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0461) (AF EOAR-62-71)
Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 854-859, Nov. 16, 1964.

Small emulsion blocks recovered from a series of Nike-Cajun rockets launched from Kronogård, Sweden, exhibit the tracks of slow heavy primary nuclei which stop by ionization in the detectors. The charge distribution of these particles, estimated from track width measurements, is consistent with a galactic origin. The kinetic energy of the particles estimated from their range resides between 60 and 570 mev nucleon. This preliminary experiment suggests that important information on the charge and energy spectra can be secured by exposing large areas of emulsion in geophysical sounding rockets.

1366

Lund U. Thermochemistry Lab. (Sweden).

THERMAL STABILITY OF ORGANIC COMPOUNDS, by S. Sunner. Apr. 15, 1964, 17p. incl. diagr. refs. (AFOSR-64-1447) (AF EOAR-62-110) AD 604474
Unclassified

One flow and one static pyrolysis apparatus directly attached to a gas chromatograph through a gas sample valve was built and their performance was studied using the four butanols as test substances. A second static pyrolysis apparatus was developed and was partly assembled. Studies were started on the use of a novel principle for building up a thermal shield for adiabatic calorimetry over a wide temperature range. It is based on the use of microconductors consisting of an inner conductor insulated with magnesia within an outer thin-walled metal tube, 0.25 - 1.00 mm in diameter. The mass of the shield consists almost entirely of the leads. The use of two types of microconductors is presently being investigated—one with platinum wire serving as a resistance thermometer and the second with chromel to be used as a heater. (Contractor's abstract)

1367

Lyon U. [Dept. of Physiology] (France).

NEUROPHYSIOLOGICAL INHIBITORY SYSTEMS ACTIVE DURING SLEEP, by M. Jouvet. Final technical rept. Jan. 1962-July 1964 [28]p. incl. refs. (AFOSR-64-1307) (AF EOAR-62-67) AD 603737
Unclassified

It was concluded that slow sleep and paradoxical phases (P. P.) are qualitatively different states of the nervous system, and that sleep cannot be considered as a unique continuous state. In fact, both ontogeny and philogeny show that two different states may be differentiated. Among the phasic phenomena occurring during P. P., the ponto-geniculo-visual activity (monophasic spikes occurring alone or in clusters) which accompanies the occurrence of rapid eye movements (REM) was investigated: both phenomena are triggered from the pons and the organization REM in different chronic preparations is described. The importance of a colliculo-mesencephalic region for the occurrence of clusters of REM is emphasized, and the dual role of the cortex (visual facilitatory, frontal inhibitory) has been shown. All these results suggest that some complex mechanism integrates rapid eye movements during sleep. The characteristic EMG activity of the extraocular eye muscles during P. P. is also emphasized.

1368

Lyon U. [Dept. of Physiology] (France).

[PHASIC ELECTRICAL ACTIVITY OF THE CORTEX AND OF THE THALAMUS DURING DESYNCHRONIZED SLEEP IN THE CAT] L'activité électrique phasique du cortex et du thalamus au cours du sommeil désynchronisé chez le Chat, by J. A. Hobson. [1964] [5]p. incl. illus. diagr. (AFOSR-65-2252) (AF EOAR-62-67) AD 625342
Unclassified

Also published in Compt. Rend. Seances Soc. Biol., v. 158: 2 31-2135, Nov. 16, 1964.

Synchronous phasic spikes were found in the visual system in the thalamus and in the "associative" cortex during the desynchronized phase of sleep.

1369

Lyon U. [Dept. of Physiology] (France).

[STATISTICAL STUDY OF THE SLEEP-WAKING CYCLE IN THE CAT] Etude statistique du cycle veille-sommeils chez le Chat, by F. Delorme, P. Vimont, and D. Jouvet. [1964] [3]p. incl. diagr. tables. (AFOSR-65-2671) (AF EOAR-62-67) AD 629203 Unclassified

Also published in Compt. Rend. Seances Soc. Biol., v. 158: 2128-2130, Nov. 16, 1964.

The cat sleeps 68.5% of the time. Behavioral sleep is divided into 77% "slow" sleep and 23% paradoxical. The average duration of paradoxical sleep is 5 min, 45 ± 80 sec.

1370

Lyon U. [Dept. of Physiology] (France).

[EFFECTS OF RESERPINE, DOPA AND 5 HTP ON
THE TWO STATES OF SLEEP] Effets de reserpine,
DOPA et 5 HTP sur les deux états de sommeil, by
J. Matsumoto and M. Jouvet. [1964] [4]p. incl. diagr.
(AFOSR-65-2673) (AF EOAR-62-67) AD 629216
Unclassified

Also published in Compt. Rend. Seances. Soc. Biol.,

v. 158: 2137-2140, Nov. 16, 1964.

Reserpine in dose 0.5 mg/kg causes a diminution of
slow sleep and a total disappearance of paradoxical
sleep with a slower return to normal in four days.
Reserpine followed by 5 HTP does not affect slow sleep
but paradoxical sleep is abolished or reduced for three
days. Reserpine followed by DOPA suppressed para-
doxical sleep more strongly, with a return to normal
the next day. It seems that variations in cerebral
catecholamine may effect paradoxical sleep.

1371

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

QUADRUPOLE RELAXATION FOR A SPIN I = 3/2. THE F^{19} N. M. R. SPECTRA OF BF_3 AND ClO_3F, by J. Bacon, R. J. Gillespie, and J. W. Quail. [1963] [7]p. incl. diagrs. refs. (AFOSR-64-0130) (AF AFOSR-62-21) AD 430943   Unclassified

Also published in Canad. Jour. Chem., v. 41: 3063-3069, 1963.

An expression is derived for the broadening of the components of the quartet obtained for the nmr spectrum of nuclei coupled to a nucleus of spin 3/2 undergoing electric quadrupole relaxation. It is shown that the F^{19} spectra of BF_3 and ClO_3F at various temperatures may be satisfactorily interpreted by means of this expression. Activation energies for molecular reorientation of 1.4 kcal/mol for BF_3 and 1.0 kcal/mol for ClO_3F are obtained. (Contractor's abstract)

1372

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

ANTIMONY TETRAFLUORIDE MONOFLUOROSULPHATE: PREPARATION, PROPERTIES, AND STRUCTURE, by R. J. Gillespie and R. A. Rothenbury. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-64-0576) (AF AFOSR-62-21) AD 434309   Unclassified

Presented at Symposium on Inorganic Fluorine Chemistry, Argonne Nat'l. Lab., Sept. 4-6, 1963.

Also published in Canad. Jour. Chem., v. 42: 416-420, 1964.

When antimony pentafluoride is refluxed with sulfur trioxide, a new compound with the composition $SbF_5 \cdot SO_3$ is formed together with sulfuryl fluoride, disulfuryl fluoride, and small amounts of the higher polysulfuryl fluorides. This compound is a colorless, very viscous liquid. From the chemical analysis, the F^{19} nmr spectrum, and the Raman and infrared spectra of the liquid it was concluded that the compound is antimony tetrafluoride monofluorosulphate $SbF_4(SO_3F)$ and that it is highly polymerized in the liquid state by fluorosulphate bridges that can have either a cis or a trans orientation with respect to each other; the former occurring to a greater extent than the latter. (Contractor's abstract)

1373

McMaster U. [Dept. of Chemistry] Hamilton, Ont. (Canada).

NUCLEAR MAGNETIC RESONANCE STUDIES OF THE PROTONATION OF WEAK BASES IN FLUOROSULPHURIC ACID, by T. Birchall and R. J. Gillespie. [1964] [12]p. (AFOSR-64-0935) (AF AFOSR-62-21) AD 439977   Unclassified

Also published in Canad. Jour. Chem., v. 42: 502-513, 1964.

The proton magnetic resonance spectra of solutions of mesitylene, durene, pentamethylbenzene, hexamethylbenzene, m- and p-xylenes, and anisole have been studied in fluorosulfuric acid and protonation on the ring carbon atom established. Rates of proton exchange have been measured and activation energies calculated for the proton exchange process. Intermolecular exchange with the solvent is suggested as the most probable exchange process in all cases.

1374

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

IODINE CATIONS AND OXYCATIONS. I. SOLUTIONS OF IODIC ACID IN SULFURIC ACID, by R. J. Gillespie and J. B. Senior. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-64-0936) (AF AFOSR-62-21) AD 439978   Unclassified

Also published in Inorg. Chem., v. 3: 440-444, Mar. 1964.

Solutions of iodic acid in sulfuric acid have been studied by means of cryoscopic and conductometric measurements. No evidence was obtained for the formation of the iodyl cation IO_2^+ or the iodic acidium ion $H_2IO_3^+$, and it appears that iodic acid is converted to solvated and polymerized forms of iodyl hydrogen sulfate, $IO_2 \cdot H_2SO_4$. (Contractor's abstract)

1375

McMaster U. [Dept. of Chemistry] Hamilton, Ont. (Canada).

SULFUR AND SILICON ISOTOPE EFFECTS IN FLUORINE NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY, by R. J. Gillespie and J. W. Quail. [1963] [3]p. (AFOSR-64-0157) (AF AFOSR-64-516) AD 432772   Unclassified

Also published in Jour. Chem. Phys., v. 39: 2555-2557, Nov. 15, 1963.

Satellites due to fluorine on S^{33} have been observed in the F^{19} nmr spectrum of sulfur hexafluoride. Values of the S^{33}-F coupling constant and of the S^{33} isotope effect on the fluorine chemical shift have been obtained from the spectrum. A S^{34} isotope effect has also been observed on the fluorine chemical shift of sulfur hexafluoride and other sulfur-fluorine compounds. Si^{29} isotope effect on the fluorine chemical shift has been observed for silicon tetrafluoride.

1376

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

CATIONS AND OXYCATIONS OF IODINE. II. SOLUTIONS OF IODOSYL SULFATE, IODINE DIOXIDE, AND IODIC ACID-IODINE MIXTURES IN SULFURIC ACID AND DILUTE OLEUM, by R. J. Gillespie and J. B. Senior. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1529) (AF AFOSR-64-516) AD 445956
Unclassified

Also published in Inorg. Chem., v. 3: 972-977, July 1964.

Solutions in sulfuric acid of iodosyl sulfate, iodine dioxide, and mixtures of iodic acid and iodine having the mol ratio $HIO_3/I_2 = 3$ have been studied by means of cryoscopic and conductometric measurements. It is concluded that iodosyl hydrogen sulfate, $IO.HSO_4$, which behaves as a weak electrolyte, is formed in each case. The results of similar measurements on solutions of the same solutes in dilute oleum lead to the conclusion that more sulfated species such as $(HSO_4)_2IO(HSO_4)_2$ and $I(HSO_4)_3$ and related polymers are formed under these conditions. (Contractor's abstract)

1377

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

THE STEREOCHEMISTRY OF FIVE-CO-ORDINATION. PART I. NON-TRANSITION ELEMENTS, by R. J. Gillespie. [1963] [7]p. incl. diagrs. refs. (AFOSR-64-1530) (AF AFOSR-64-516) AD 446403
Unclassified

Also published in Jour. Chem. Soc. (London), Oct. 1963, p. 4672-4678.

The stereochemistry of five-co-ordination in molecules of the non-transition elements is discussed in terms of the theory of valency-shell electron-pair repulsions. It is shown that this theory provides a better explanation for the observed bond lengths and bond angles in both trigonalbipyramidal and square-pyramidal molecules than does the conventional theory of directed valency based on hybrid orbitals. The discussion includes a consideration of molecules with a doubly bonded oxygen atom as one of the ligands, e.g., SOF_4, trigonal-bipyramidal transition states, and pseudorotation in trigonal-bipyramidal molecules. (Contractor's abstract)

1378

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

THE STEREOCHEMISTRY OF FIVE-CO-ORDINATION. PART II. TRANSITION ELEMENTS, by R. J. Gillespie. [1963] [7]p. incl. diagrs. table, refs. (AFOSR-64-1531) (AF AFOSR-64-516) AD 447665 Unclassified

Also published in Jour. Chem. Soc. (London), Oct. 1963, p. 4679-4685.

The stereochemistry of five-co-ordination in molecules of the transition elements is discussed in terms of the theory of valency-shell electron-pair repulsions. For transition elements with d^0 and d^{10} configurations, as for non-transition elements, the trigonal-bipyramidal shape determined by the interactions between the five electron pairs in the valency shell, is preferred. For other less symmetrical d-shell configurations it is necessary to consider the interaction of the valency-shell electron pairs with the d-shell as well as with each other. It is shown that generally this additional interaction results in the square-pyramid's becoming more stable than the trigonal bipyramidal. Examples of both trigonal-bipyramidal and square-pyramidal molecules of the transition metals are described and discussed. (Contractor's abstract)

1379

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

IODINE OXIDE PENTAFLUORIDE, by R. J. Gillespie and J. W. Quail. [1963] [1]p. incl. diagr. refs. (AFOSR-64-1532) (AF AFOSR-64-516) AD 446138
Unclassified

Also published in Proc. Chem. Soc. (London), Sept. 1963, p. 278.

The reaction of iodine heptafluoride with silica at 100° in a sealed silica tube yielded iodine oxide pentafluoride, IOF_5, a new compound of iodine. The reaction was followed by means of F^{19} nuclear magnetic resonance spectroscopy. The extremely broad iodine heptafluoride resonance was gradually replaced by a broad doublet and quintet on the low-field side of the relatively sharp doublet and quintet due to iodine pentafluoride. A small amount of iodine pentafluoride was present as an impurity in the heptafluoride. This spectrum clearly arises from a new compound containing 4 equivalent F atoms and a fifth non-equivalent F atom. Since the chemical shift of the 2 multiplets is intermediate between those of iodine penta- and hepta-fluoride, the only reasonable compound to which the spectrum can be attributed is to iodine oxide pentafluoride.

1380

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

THE ^{19}F N.M.R. SPECTRUM OF IF_7, by R. J. Gillespie and J. W. Quail. [1964] [3]p. incl. diagr. refs. (AFOSR-65-0230) (AF AFOSR-64-516) AD 611453
Unclassified

Also published in Canad. Jour. Chem., v. 42: 2671-2673, 1964.

It is shown that the line shape calculated for the nmr spectrum of a magnetic nucleus attached to a nucleus

of spin 5/2 undergoing quadrupole relaxation agrees well with the observed spectrum of iodine heptafluoride. The iodine-fluorine coupling constant was found to be $J_{IF} \simeq 2\,100$ c/s. The apparent magnetic equivalence of the fluorine atoms in IF_7 is discussed. (Contractor's abstract)

1381

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

SELENIUM ISOTOPE EFFECTS IN FLUORINE NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY, by T. Birchall, S. L. Crossley, and R. J. Gillespie. [1964] [2]p. incl. tables, refs. (AFOSR-65-0385) (AF AFOSR-64-516) AD 611733   Unclassified

Also published in Jour. Chem. Phys., v. 41: 2760-2761, Nov. 1, 1964.

A selenium isotope effect on the fluorine chemical shift has been observed in several selenium-fluorine compounds for all of the naturally occurring selenium isotopes except Se^{74}. Values for some Se^{77}-F^{19} coupling constants are reported. (Contractor's abstract)

1382

McMaster U. Dept. of Metallurgy and Metallurgical Engineering, Hamilton, Ont. (Canada).

OXIDATION OF METALS AND ALLOYS, by W. W. Smeltzer. Final rept. Oct. 1961-Oct. 1963, 1v. incl. illus. diagrs. tables, refs. (AFOSR-J1356) (AF AFOSR-61-108) AD 432718   Unclassified

Basic research was carried out on the oxidation properties of metals and alloys, diffusion and thermodynamic properties of metallic oxides. Measurements were made on the kinetics of oxide film and scale growths. Metallographic, hot stage microscopes and x-ray techniques were employed to examine oxide structures. These studies were augmented by electrochemical measurements and electron microscopy of the metal/oxide composite systems. (Contractor's abstract)

1383

McMaster U. [Dept. of Metallurgy and Metallurgical Engineering] Hamilton, Ont. (Canada).

THE OXIDATION KINETICS OF ZIRCONIUM IN THE TEMPERATURE RANGE 400-600°C, by R. J. Hussey and W. W. Smeltzer. [1964] [5]p. (AFOSR-64-1224) (AF AFOSR-61-108) AD 442802   Unclassified

Also published in Jour. Electrochem. Soc., v. 111: 564-568, May 1964.

The oxidation kinetics of zirconium were determined in the temperature range 400-600°C at subatmospheric pressures for exposure times of 650 hr at 400°C to 160 hr at 600°C by a microbalance technique. From

scale thickness measurements, it was shown that at temperatures between 500-600°C the amount of oxygen in the metal varies from 14 to 23% of the total oxygen consumption respectively. Further both the oxidation kinetics and the oxygen distribution between the metal and the oxide were found to be independent of changes of oxygen pressure from 0.25 to 50 cm Hg.

1384

McMaster U. Dept. of Metallurgy and Metallurgical Engineering, Hamilton, Ont. (Canada).

THE PARABOLIC OXIDATION KINETICS OF ALPHA-ZIRCONIUM AT 850°C, by G. R. Wallwork, W. W. Smeltzer, and C. J. Rosa. [1964] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1227) (AF AFOSR-61-108) AD 442817   Unclassified

Also published in Acta Metall., v. 12: 409-415, Apr. 1964.

An investigation is reported on the oxidation properties of alpha-zirconium at 850°C in oxygen for exposures extending to 400 hr. The kinetics were determined by volumetric and gravimetric techniques and may be represented for exposures to approximately 200 hr by a parabolic relationship. Scale thicknesses and oxygen gradients in the metal were determined by metallographic techniques. It is demonstrated that parabolic diffusion relationships derived from an oxide-metal model account for the kinetics of oxidation, scale growth and oxygen solution in the metal. (Contractor's abstract)

1385

McMaster U. [Dept. of Metallurgy and Metallurgical Engineering] Hamilton, Ont. (Canada).

THE DISSOCIATION PRESSURES OF IRON-NICKEL OXIDES, by G. A. Roeder and W. W. Smeltzer. [1964] [5]p. (AFOSR-64-2108) (AF AFOSR-61-108) AD 451720   Unclassified

Also published in Jour. Electrochem. Soc., v. 111: 1074-1078, Sept. 1964.

Electromotive force determinations are reported of solid galvanic cells consisting of a ZrO_2-CaO electrolyte with iron-nickel-oxygen electrodes. To test the design of cells containing embedded electrodes of the reaction metals, dissociation pressures for wustite, magnetite, and nickel oxide were determined and compared with reported values. The standard molar free energy change of the reaction between nickel oxide and wustite and the dissociation pressures of wustite equilibrated with iron-nickel alloys containing nickel to 47.2 a/o were determined at temperatures in the range 800°-1000°C.

1386

McMaster U. [Dept. of Metallurgy and Metallurgical Engineering] Hamilton, Ont. (Canada).

THE MECHANISM OF OXIDATION OF ZIRCONIUM IN

THE TEMPERATURE RANGE 400°-850°C, by R. J.
Hussey and W. W. Smeltzer. [1964] [4]p. incl. diagrs.
table. (AFOSR-65-0184) (AF AFOSR-64-515)
AD 611503   Unclassified

Also published in Jour. Electrochem. Soc., v. 111:
1221-1224, Nov. 1964.

A study of the oxidation mechanism for zirconium in
the temperature range 400-850°C, based on examination
of the oxide scale growth and oxygen gradients in the
metal substrate, is reported. The oxidation kinetics at
long times obeyed a parabolic rate equation which was
best described in terms of a diffusion model for oxygen
diffusion in both the oxide and metal. From the deter-
mination of the oxygen gradients, the diffusion constant
was evaluated for oxygen diffusion in alpha-zirconium.

1387

McMaster U. Dept. of Physics, Hamilton, Ont. (Canada).

NEUTRON SEPARATION ENERGIES FOR ZIRCONIUM
AND THE Zr^{96}-Nb^{96} NAD Nb^{94}-Zr^{94} DECAY ENER-
GIES, by R. C. Ba ber, R. L. Bishop and others.
[1963] [6]p. incl. diagrs. tables. (AFOSR-J650)
(AF AFOSR-62-33) AD 413466   Unclassified

Also published in Jour. Phys., v. 41: 696-701, 1963.

Values are reported for the Zr^{92}-Zr^{90}, Zr^{94}-Zr^{92},
and Zr^{96}-Zr^{94} mass differences. These are combined
with existing data to compute neutron separation ener-
gies for Zr^{94} and Zr^{96}, and the energies available for
the Zr^{96}-Nb^{96} and Nb^{94}-Zr^{94} decays. It is pointed out
that marked regularities exist among the neutron separa-
tion energies for zirconium and tin. (Contractor's
abstract)

1388

McMaster U. [Dept. of Physics] Hamilton, Ont. (Canada).

STOPPING CROSS SECTIONS IN CARBON FOR LOW-
ENERGY ATOMS WITH Z LESS THAN OR EQUAL TO
12, by J. H. Ormrod and H. E. Duckworth. [1963]
[19]p. (AFOSR-J1248) (AF AFOSR-62-33) AD 424322
                                    Unclassified

Also published in Canad. Jour. Phys., v. 41: 1424-
1442, 1963.

The electronic stopping cross sections in carbon for
atomic projectiles with $Z \leq 12$ have been determined in
the energy interval from 10 to 140 kev. In doing so a
Monte Carlo calculation was used to subtract from each
experimentally observed cross section the contribution
which arises from nuclear scattering. The trend of
the results thus obtained agrees well with theory. In
addition, however, a periodic dependence of S_e on the
atomic number of the projectile is observed.

1389

McMaster U. [Dept. of Physics] Hamilton, Ont. (Canada).

SOME NEUTRON SEPARATION ENERGIES FOR
ISOTOPES OF Hg, Tl, Pb, AND Bi, by W. McLatchie,
R. C. Barber and others. [1964] [11]p. (AFOSR-64-
1144) (AF AFOSR-63-159) AD 442829   Unclassified

Also published in Canad. Jour. Phys., v. 42: 926-936,
May 1964.

Values derived from mass spectral doublets are reported
for isotopic mass differences of the following elements:
Hg, Tl, Pb, and Bi. The mass differences are combined
with existing reaction and disintegration data to yield
single- and double-neutron separation energies for
several of the isotopes of the above elements. The re-
sulting neutron separation energy curves for even N are
strikingly similar in shape and all exhibit an abrupt
change in slope at N = 124. The curves for odd N do not
display the same regularity. Currently accepted values
for the total decay energies Tl^{204} and Tl^{202}-Hg^{202} are
probably too large and too small, respectively, but
current values for Pb^{205}-Tl^{205} and Bi^{208}-Pb^{208} are
confirmed.

1390

McMaster U. Dept. of Physics, Hamilton, Ont. (Canada).

THE SHAPE OF THE MASS SURFACE IN THE REGION
OF 90 NEUTRONS, by H. E. Duckworth, R. C. Barber
and others. [1964] [2]p. incl. diagr. table. (AFOSR-
67-1757) (AF AFOSR-64-159)   Unclassified

Also published in Proc. Internat'l. Cong. Nuclear
Phys., Paris (France) (July 2-8, 1964), ed. by P.
Gugenberger, v. 2: 557-558, 1964.

A high resolution mass spectrometer was used to de-
termine double-neutron separation energies for many of
the stable nuclides with $84 \leq N \leq 98$. These values,
together with others that may be calculated from them
by use of existing data, are listed and presented graph-
ically.

1391

Madrid U. Dept. of Crystallography (Spain).

[USE OF AN OPTICAL ANALOG IN THE STUDY OF
DIFFUSE X-RAY DIFFRACTION IN CRYSTALS]
Empleo de analogos opticos en el estudio de la difraccion
difusa de rayos X por los cristales, by M. L. Canut,
L. M. Valdes, and J. L. Amoros. [1963] [15]p. incl.
illus. diagrs. refs. (AFOSR-J1129) (AF EOAR-62-92)
AD 421716   Unclassified

By using the analogy between x-ray and light diffraction
phenomena, the interpretation of the observed x-rays
diffuse scattering arising from crystal imperfections
such as thermal or positional disorder can easily be
done in terms of Fraunhofer patterns and Q-functions
of proper statistical disordered models. Some optical
instruments, i.e., optical diffractometer, Q-integrator

and Eller machine were used for the study of the diffuse scattering. It is shown that in the case of anthracene the optical diffraction pattern of a model where rigid body random translational displacements were introduced gives the continuous diffuse regions detected by x-rays and it corresponds to our DFT function. This permits the prediction of the x-rays continuous diffuse scattering regions in molecular crystals, as it is given in the crystal of benzene. (Contractor's abstract, modified)

1392

Madrid U. Dept. of Crystallography (Spain).

[CRYSTAL SURFACES. IV. DISTRIBUTION, GENERA-TION AND MOVEMENT OF DISLOCATIONS IN PYRITE] Superficies de cristales. IV. Distribución, generación y movimento de dislocaciones en pirita, by J. L. Amoros and M. T. Pascual. [1963] [11]p. incl. illus. diagrs. refs. (AFOSR-J1557) (AF EOAR-62-92) AD 427715   Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 61: 39-49, 1963.

Distribution, generation, and movement of dislocations are studied via etch pits in pyrite (FeS$_2$). The concentration of approximately 2000 dislocations/cm^2 is observed in good crystals. Arrays and forests of dislocations are observed in good and bad crystals respectively. The arrays follows the [100], [210] and [320] directions, which coincide with the PBC vectors previously determined. Movement and generation of dislocations are observed in good crystals under compression and by quenching. Loop nucleation from vacancies and cross gliding screw dislocations mechanism are taken into account to explain the observed facts. Linear and curved cross slipping dislocations are observed, giving rise to characteristic features in the perfect surface of good crystals, that eventually give rise to crack nucleation. (Contractor's abstract)

1393

Madrid U. Dept. of Crystallography (Spain).

[CRYSTAL GROWTH. I. GROWTH VELOCITIES IN CONDITIONS OF COMPETENCE] Crecimiento de cristales. I. Velocidades de crecimento en condiciones de competencia, by J. L. Amorós, E. Martín, and P. Tavira. [1963] [14]p. incl. illus. diagrs. table, refs. (AFOSR-64-0457) (AF EOAR-62-92) AD 435667
Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 61: 187-200, 1963.

The growth velocities of different faces of MASD, TGS, and NaNO$_2$ are studied by the method of the drop. The influence of neighbors is determined as a function of growth competence, that causes important changes in the distribution of concentration of the solution causing development of new faces of high indices. These features coincide with a change of the slope of corresponding growth curves. The impurity concentration is extremely

important in the growth of NaNO$_2$ single crystals, namely producing hollow crystals by changing the rate of the relative velocities of the equilibrium form of the crystal. (Contractor's abstract)

1394

Madrid U. Dept. of Crystallography (Spain).

[THE THERMAL EXPANSION OF POTASSIUM NITRATE (NITER)] La dilatación térmica del nitro, NO$_3$K (sal de piedra), by J. L. Amorós, M. Gutiérrez, and M. L. Canut. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-64-2078) (AF EOAR-62-92) AD 452049   Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 62: 23-39, 1964.

The thermal expansion of orthorhombic KNO$_3$ was determined from x-ray Weissenberg photographs in the low temperature range (-170° to 20°C). The three mean section of the thermal expansion ellipsoid and values of the mean expansion coefficients were calculated. Functions giving the temperature dependence of the lattice parameters were obtained. The theory of Hartman was applied to the KNO$_3$ structure and the most relevant periodic-bond-chains (PBC)-vectors deduced. A general comparison of the thermal expansion of nitrates and carbonates of similar structure is also given.

1395

Madrid U. Dept. of Crystallography (Spain).

[ON THE THERMAL EXPANSION OF THE FERRO-ELECTRIC SODIUM NITRITE] Sobre la dilatación térmica del nitrito dódico ferroeléctrico, by J. L. Amorós, M. Gutiérrez, and M. L. Canut. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-64-2079) (AF EOAR-62-92) AD 452048   Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 62: 5-21, 1964.

Thermal behavior of NaNO$_2$ has been studied in the ferroelectric phase (between -180° and 155°C). Thermal expansion has been determined at low temperature and below the transition point. The thermal expansion coefficients have been found and equations giving the variation of the cell parameters with temperature have been determined. The periodic-bond-chain scheme gives qualitative account of the thermal behavior of the crystal. A new function, the temperature difference Fourier synthesis is developed, and it is applied to the study of the changes in the structure with temperature. Evidence is found of a drastic change of the "vibration" ellipsoid of Na$^+$ and of the presence of NO$_2^-$ groups in a reversal position as the crystal is approaching the transition temperature. The results are discussed in relation to other already known thermal properties of NaNO$_2$. (Contractor's abstract, modified)

1396

Madrid U.   of Crystallography (Spain).

[CRYSTAL GROWTH, DISLOCATIONS AND FRACTURE]
Crecimiento, dislocaciones y fractura cristalinos, by
J. L. Amoros. [1963] [26]p. incl. illus. diagrs. table,
refs. (AFOSR-64-2080) (AF EOAR-62-92) AD 451586
                                              Unclassified

Also published in Bol. Acad. Nac. Cien., v. 43: 177-
202, 1963.

In this paper the main features of the growth and dis-
location production were studied as well as the emergence
of dislocations on the surface of a crystal by the etch
method. The theory was applied to the interpretation of
important surface features observed in pyrite crystals.
The morphology of the observed macroscopic layers of
growth was interpreted in terms of the periodic bond
chain theory. The main mechanism of growth of pyrite
crystals has been discovered. Evidence has been found
of polygonal spirals in the surface of the crystals. The
presence of scattered dislocations as well as clusters
of dislocations have been observed. Slip and loop dis-
locations have been observed and the mechanism ex-
plained. The nucleation of microcracks have been
studied in relation to the main cleavage plains and applied
stress. (Contractor's abstract, modified)

1397

Madrid U. Dept. of Crystallography (Spain).

[ON THE VIBRATIONAL ELASTIC SPECTRUM OF A
MOLECULAR CRYSTAL (HEXAMINE) FROM TEM-
PERATURE DIFFUSE SCATTERING OF X-RAYS]
Determinación del espectro elástico vibracional de un
cristal molecular, la hexamina, por difracción difusa
térmica de rayos X, by A. Carbonell and M. L. Canut.
[1964] [14]p. incl. diagrs. tables, refs. (AFOSR-64-
2081) (AF EOAR-62-92) AD 452416   Unclassified

Also published in Rev. Cien. Apl., No. 97: 126-139,
Mar.-Apr. 1964.

Absolute diffractometric measurements along [100],
[110] and [111] in the first Brillouin zones 440, 222 and
800 have been made at room temperature in hexamine
by using x-ray Cu monochromatized radiation. A dy-
namical model has been considered consisting of rigid-
body translational molecular motion, i.e., neglecting
both librations of the molecules and intramolecular vi-
brations. Under this assumption, the Born theory of
lattice dynamics together with the Laval theory of diffuse
scattering has been applied to this primitive (rhombo-
hedral) monomolecular lattice, and the dispersion
curves of frequencies and velocities of the three
acoustic branches, the seven intermolecular force con-
stants corresponding to interactions between first,
second and third neighbors and an approximate elastic
vibrational spectrum of hexamine have been obtained.
The results are compared with the b.c.c. lattices of
α-iron and lithium. (Contractor's abstract, modified)

1398

Madrid U. Dept. of Crystallography (Spain).

[THERMAL EXPANSION AND STACKING DISORDER
IN MOLECULAR CRYSTALS. I. 2,2'-PYRIDIL]
Dilatación termica y desorden de apilamiento en cristales
moleculares. I. 2,2'-piridil, by A. Felix, M. L.
Canut, and J. L. Amoros. [1964] [11]p. incl. illus.
diagrs. (AFOSR-65-0742) (AF EOAR-62-92)
AD 615068   Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G),
v. 62: 187-197, 1964.

The thermal expansion quadric of 2,2'-pyridil has been
determined by the Weissenberg method, between -175°
and 20°C. The monoclinic crystal shows the maximum
($\alpha_{11} = 167.3 \times 10^{-6}$) and minimum ($\alpha_{33} = 12.7 \times 10^{-6}$)
expansion in the plane (010). Although the bond system
does not involve other bonds but van der Waals forces,
the thermal expansion coefficients are smaller than the
expected. 2,2'-pyridil is formed by curled sheets of
molecules formed by chains of molecules along [101].
This causes some possibility of stacking lines along
rows of $l = 1$ (from 011 to 021) and $l = 3$ (from 013
to 043) which have been detected in Weissenberg and
Laue photographs of some single crystals. A two di-
mensional statistical model where stacking disorder
along [001] of the layers of molecules has been introduced
gives a Fraunhofer pattern showing general agreement
with the x-ray experiments. Both ordered and dis-
ordered crystals can be obtained from a solution of the
substance in ethanol. (Contractor's abstract)

1399

Madrid U. Dept. of Crystallography (Spain).

[A STUDY OF THE TOPOGRAPHY OF CRYSTALLINE
IMPERFECTIONS BY THE PARALLEL BEAM METHOD
OF X-RAY DIFFRACTION] Estudio topográfico de las
imperfecciones de un cristal por diffración de rayos X;
método del laz paralelo, by J. L. Amorós and P.
Tavira. [1964] [6]p. incl. illus. diagrs. refs. (AFOSR-
65-0743) (AF EOAR-62-92) AD 616061 Unclassified

Also published in Rev. Cien. Apl., No. 98: 217-222,
May-June 1964.

The theoretical background of the parallel beam
method is discussed. The intensity of the diffracted
beam is proportional to $|F(h)|$ or $|F(h)|^2$ according to
the dynamical or geometrical theory, respectively.
The dynamical theory holds for a perfect crystal and
the geometrical theory for a mosaic crystal. If $|F(h)|$
is high for a given crystal plane, the difference between
both intensities becomes remarkable and the situation
can be used for studying the topography of the perfection
of a crystal. A camera following Barth ideas has been
built and the experimental results discussed. The new
camera allows the observation of the topography of the
perfection of a crystal under thermal strain enhancing
the potentiality of the method. The camera can also be
used in transmission technique where use is made of the
anomalous absorption of x-rays by perfect crystals.
(Contractor's abstract)

1400

[Madrid U. Dept. of Crystallography (Spain)]

[CROSS-GLIDING OF DISLOCATIONS IN PYRITE SURFACE] Deslizamiento cruzado ("cross-gliding") de di:'o-aciones en la superficie de la pirita, by J. L. Amorós and M. T. Pascual. [1964] [4]p. incl. illus. (AFOSR-65-1923) (AF EOAR-62-92) AD 626776
Unclassified

Also published in Estudios Geologicos, v. 20: 73-76, Nov. 1964.

Cross-gliding of dislocations was observed in pyrite through slight etching of the free (old) surface. The cross-gliding mechanism is believed to start when the surface is freed of the oxidized bonded coating by the etching technique. Such mechanism gives rise to 2 different phenomena, one of which is related to the annihilation of dislocations of opposite sign. The intrinsic notch brittleness of pyrite crystals is revealed by microcrack nucleation. Micro-cracks are shown also by etching, and the mechanism is associated to the anchoring effect of the oxide coating of the old pyrite surface. (Contractor's abstract)

1401

Maine U. Dept. of Physics, Orono.

INFLUENCE OF AN ELECTRIC FIELD ON THE DI-ELECTRIC LOSS OF THE LIQUID CRYSTAL P-AZOXYANISOLE, by E. F. Carr. [1963] [5]p. incl. diagrs. refs. (AFOSR-J1558) (AF AFOSR-61-45) AD 427714
Unclassified

Also published in Jour. Chem. Phys., v. 39: 1979-1983, Oct. 15, 1963.

This work involves the alignment of molecules in the anisotropic liquid phase of p-azoxyanisole due to externally applied dc and ac electric fields and walls of the sample holder. Microwave techniques involving dielectric measurements are used to provide a measure of the alignment. Results are discussed which suggest that for very pure samples an alignment should be produced with the long axes of the molecules perpendicular to the externally applied electric field. The alignment with the long axes parallel to the external field which is often observed appears to be due to an extremely small amount of impurity. Results are also discussed which suggest that small amounts of impurity are effective in producing an alignment of the molecules parallel to the walls of the sample holder.

1402

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

THE EXPONENTS OF INCIDENCE MATRICES, by A. L. Dulmage and N. S. Mendelsohn. [1964] [10]p. incl. refs. (AFOSR-65-0867) (AF AFOSR-62-235) AD 617626
Unclassified

Also published in Duke Math. Jour., v. 31: 575-584, Dec. 1964.

This note investigates the multiplicative properties of non-negative matrices from a combinatorial point of view. The concepts of reducible, irreducible, and primitive matrices are discussed, and it is proved that if A is an incidence matrix of given design, $A^4 > 0$. The combinatorial description given of the pattern of zeros and nonzeros differs from others in that the concepts of graph theory are used directly. It is based on a consideration of converings of the positive entries of a non-negative matrix by proper mixtures of rows and columns. The connection of a non-negative matrix with a bipartite graph is also shown.

1403

[Marburg U. Inst. for Theoretical Physics (Germany)]

ATTEMPT OF AN AXIOMATIC FOUNDATION OF QUANTUM MECHANICS AND MORE GENERAL PHYSICAL THEORIES, by G. Ludwig. [1964] 46p. (AFOSR-65-0646) (AF 61(052)656) AD 614846   Unclassified

By introducing certain axiomatic assumptions on the production of macroscopic effects by microscopic objects attempts are made to obtain a general basic structure of physical theories. The essential features of the proposition-calculus of quantum mechanics are reproduced through it has not yet been possible to give a complete survey of mathematical realizations which might satisfy the postualtes. (Contractor's abstract)

1404

Marburg U. Inst. for Theoretical Physics (Germany).

REMARKS ON ω-φ AND OCTET-OCTET MIXING, by H. D. Doebner and G. C. Hegerfeldt. [1964] [4]p. (AFOSR-65-0647) (AF 61(052)656) AD 614849
Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1724-1727, Sept. 16, 1964.

A discussion is presented of some consequences following the assumption that the SU_3 singlet and octet or the first and second octet are degenerate in the limit of full symmetry with a common mass M_0 leading to 9 or 16 physical particles after mixing. This model allows the number of constants to be lowered by one and gives relations between masses and mixing angles. It turns out that the degenerate ω-φ mixing is in good agreement with experiment; for octet-octet mixing the model leads to predictions of unobserved resonances and is less satisfactory.

1405

Marburg U. Inst. for Theoretical Physics (Germany).

GENERAL QUANTUM FIELD THEORIES AND STRICT

LOCALITY, by K. Kraus. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0651) (AF 61(052)658) AD 615691
Unclassified

Also published in Zeitschr. Phys., v. 161: 1-12, 1964.

A class of general quantum field theories without explicit use of fields A(x) is defined by a set of postulates for the von Neumann algebras $\mathfrak{R}_C$ of local observables. The vacuum state is cyclic with respect to any $\mathfrak{R}_C$, and the Borchers tube theorem is shown to hold. Some $\mathfrak{R}_C$ are factors and not of finite type. A property of local observables called strict locality is formulated and expressed by means of a necessary and sufficient condition for the algebras $\mathfrak{R}_C$. It is proved for finite regions. (Contractor's abstract)

1406

Maremont Corp. Rocket Power, Inc., Pasadena, Calif.

RESEARCH ON CHEMICAL SYNTHESIS WITH MONO-ENERGETIC IONS, by C. Bodai, L. K. Branson and others. Final technical rept. Oct. 1, 1960-Sept. 30, 1964, 13p. incl. diagr. table, refs. (AFOSR-65-1691) (AF 49(636)913) AD 624087 Unclassified

A new technique for the synthesis of chemical compounds was developed. Pure nitrobenzene was synthesized by bombarding the benzene molecule with a beam of NO_2^+ ions under carefully controlled conditions. Ortho, meta and para nitrotoluene were also prepared by the reaction of toluene with NO_2^+ ions. The apparatus used consists of an ion source capable of providing a low-energy (1 ev) high-current (1 ma) beam of selected ionic species; an electrostatic potential control or accelerator for extracting the current from the source and giving accurate ion energies on the order of 1 ev; a reaction vessel in which the ions interact with the target molecules to produce a chemical reaction; and a cold trap to collect the products of reaction. (Contractor's abstract)

1407

Marseille U. (France).

EVOKED VISUAL RESPONSES IN MAN DURING AUDITORY STRESS, by H. J. Gastaut. Final rept. Oct. 30, 1963, 26p. (AFOSR-64-0016) (AF EOAR-62-74) AD 428239 Unclassified

A transcranial study in man of evoked visual responses due to intermittent light stimulation during silence or intense prolonged auditory stimulation is presented. These responses were recorded with conventional EEG as photic driving, or with an apparatus of integration as an average evoked potential. They are increased at the start of sound stimulation and diminished during its continuation. If due account is taken of the corresponding modifications of the fundamental EEG rhythms, one may consider these phenomena as being due to activation with subsequent inhibition of the reticular formation. This would equally explain the psychometric

changes, and the lowering of efficiency and of personnel security observed during stress by sound.

1408

Martin-Marietta Corp. Martin Co., Baltimore, Md.

EFFECT OF LOW PRESSURES ON THE MECHANICAL BEHAVIOR OF METALS, by I. R. Kramer and S. E. Podlaseck. Final rept. Oct. 1, 1962-Oct. 1, 1963, 30p. incl. diagrs. table, refs. (AFOSR-J1237) (AF 49(636)-946) AD 424292 Unclassified

Results of a study on the creep, tensile and fatigue behavior of metals at low environmental pressures are presented. Changes in the activation energy for creep of aluminum single crystals were measured as pressure was varied from 10^{-4} to 10^{-7} torr. Effects of vacuum on the tensile properties of single and polycrystalline aluminum are presented. Variations in the tensile properties of 316 stainless steel and 4043 aluminum with pressures in the range 760 to 10^{-6} torr are also presented. Variations in the fatigue life of 1100 aluminum as a function of pressure in the range 760 to 10^{-6} torr are given. (Contractor's abstract)

1409

[Martin-Marietta Corp.] Martin Co., Baltimore, Md.

EFFECT OF VACUUM ON THE MECHANICAL BEHAVIOR OF METALS, by I. R. Kramer, H. Shen, and S. E. Podlaseck. Final scientific rept. Oct. 1, 1963-Oct. 1, 1964, 36p. incl. illus. diagrs. tables, refs. (Rept. no. RR-60) (AFOSR-64-2509) (AF 49(636)946) AD 612022 Unclassified

Effects of vacuum on the various mechanical properties of aluminum have been studied as a function of pressure, strain rate, crystallographic orientation, strain, specimen size and grain size. The results obtained from a series of creep, fatigue and tensile tests indicate that these parameters are intimately related to the magnitude of the effects observed in vacuum. Experimental results obtained in vacuum for the fatigue life, the coefficient of work-hardening, the change in activation energy and the activation volume are presented. The tensile properties of pure α iron have also been studied in vacuum, and the experimental data are presented. A theoretical surface effect model based on the concept of the 'surface debris layer' is proposed to interpret all the phenomena observed in this investigation. (Contractor's abstract)

1410

Martin-Marietta Corp. Martin Co., Baltimore, Md.

EFFECT OF INITIAL IMPERFECTION ON THE STABILITY OF SHALLOW SPHERICAL SHELLS, by G. A. Thurston and F. A. Penning. Final rept. Aug. 31, 1964, 121p. incl. illus. diagrs. tables, refs. (Rept. no. CR-64-28) (AFOSR-64-1627) (AF 49(636)1316) AD 448454 Unclassified

The effect of initial imperfections in shape on the elastic buckling of clamped spherical caps under external pressure was studied. Basing the analysis on imperfection shapes determined by measurements on the actual test specimens resulted in better correlation between theory and experiment for imperfect spherical caps than has been possible in the past.

1411

Maryland U. Dept. of Physics and Astronomy, College Park.

SUPERCONDUCTORS WITH PLANE BOUNDARIES, by D. S. Falk. [1963] [55]p. incl. diagrs. refs. (Technical rept. no. 315) (AFOSR-5134) (AF AFOSR-62-46) AD 413475   Unclassified

Also published in Phys. Rev., v. 132: 1576-1590, Nov. 15, 1963.

The Gor'kov equations are solved approximately for various geometries to obtain information about the pair wave function in the vicinity of plane boundaries. The approximation method consists of assuming a model taken constant within the superconductor, and assuming it to be close to the correct pair wave function. The equations are then solved and a new pair wave function is calculated. The model is then chosen in a self-consistent manner. The problems considered are the finite and semi-infinite superconducting slabs, and semi-infinite superconducting and normal metals in contact. The effects of the boundary conditions are discussed. The calculations are performed both at zero temperature and near the critical temperature.

1412

Maryland U. Dept. of Physics and Astronomy, College Park.

LOCALIZED MODE DETECTION BY MEANS OF THE MÖSSBAUER EFFECT, by A. D. Dinhofer. Doctoral thesis, June 1963, 39p. incl. diagr. refs. (Technical rept. no. 312) (AFOSR-5139) (AF AFOSR-62-46) AD 412526   Unclassified

Also published in Phys. Rev., v. 131: 535-539, July 15, 1963. (AFOSR-64-0437; AD 435651)

The Mössbauer effect in a simple cubic crystal, disordered by light isotopes was studied for the possibility of observing the localized mode vibrational spectrum over the background of the continuum.

1413

Maryland U. Dept. of Physics and Astronomy, College Park.

[FUNDAMENTAL INTERACTIONS IN THE SOLID STATE] by R. A. Ferrell and R. D. Myers. Final rept. Sept. 1, 1961-Aug. 31, 1964, 10p. incl. refs. (AFOSR-65-0656) (AF AFOSR-62-46) AD 514136
                Unclassified

This is a theoretical investigation of fundamental problems in solid state physics with emphasis on the treatment of particle correlation arising in the many-body problem by modern methods of quantum field theory. Detailed study of the superconducting state of metals, giving attention to the basic theory of the electron-phonon and phonon-exchange interaction, will be undertaken to derive the correct superconductivity criterion. In addition, polarization of the degenerate electron gas by a point charge will be computed, exchange corrections in the dielectric constant of a degenerate electron gas will be determined, and the existence of localized lattice vibrational modes explored.

1414

Maryland U. Dept. of Physics and Astronomy, College Park.

CORRELATION EFFECTS AND THE HELICON DISPERSION RELATION, by R. E. Prange. [1964] [2]p. (AFOSR-65-0740) (AF AFOSR-62-46) AD 615351
                Unclassified

Also published in Phys. Ltrs., v. 12: 181-162, Oct. 1, 1964.

The model of metals based on the Fröhlich Hamiltonian of the electron-phonon interaction can be described by a generalized Landau Fermi-liquid theory. This note considers such a case in which the only possible role of the phonons is in the renormalization of the electronic energies and matrix elements. The helicon dispersion relation is obtained, and it is shown that there are no interaction corrections to the relation.

1415

Maryland U. [Dept. of Physics and Astronomy] College Park.

ON THE GINZBURG-LANDAU EQUATIONS, by R. W. Carroll and A. J. Glick. [1964] [12]p. incl. refs. (AFOSR-66-1344) (AF AFOSR-62-46) AD 641097
                Unclassified

Also published in Arch. Rational Mech. and Anal., v. 16: 373-384, 1964.

Existence and uniqueness theorems for weak solutions of the nonlinear Ginzburg-Landau partial differential equations are proven. The results are based on a contraction mapping principle and require the parameter K in the equations and the strength of the external magnetic field to be small.

1416

Maryland U. [Dept. of Physics and Astronomy] College Park.

EXPERIMENTAL AND THEORETICAL RESEARCH IN GRAVITATION PHYSICS, by G. Hinds, J. Sinsky and others. Final technical rept. 1963, 17p. (AFOSR-5207) (AF AFOSR-62-143) AD 416608   Unclassified

Research has continued on the generator of dynamical gravitational fields, in the vicinity of 1657 cps. The generator consists of an aluminum cylinder, 8 in. in diam, 60 in. long, suspended in a vacuum chamber. A vacuum tube oscillator drives piezo electric crystals secured to the cylinder, and the cylinder is excited in its lowest compressional mode. A principal objective of the research was accomplished. The cylinder was successfully driven at strain amplitudes as high as 5×10^{-4}. It can be reliably driven at strain amplitudes of 2×10^{-4}. Temperature drift of the cylinder was observed which resulted in a drift of its resonant frequency.

1417

Maryland U. Dept. of Physics and Astronomy, College Park.

RELATIVISTIC PARTICLE DYNAMICS AND THE S MATRIX, by R. Fong and J. Sucher. July 1963, 28p. incl. refs. (Technical rept. no. TR-319) (AFOSR-65-0503) (AF AFOSR-62-361) AD 439077
Unclassified

Also published in Jour. Math. Phys., v. 5: 456-470, Apr. 1964.

Direct-interaction theories are examined from the viewpoint of relativistic scattering theory and the associated concept of "asymptotic covariance". It is pointed out that with any 2-particle Hamiltonian which has no bound states there can be associated a variety of representations of the Lie algebra of the inhomogeneous Lorentz group (IHLG), although the S matrix is in general not covariant. It is shown that the requirement of the asymptotic covariance ensures both the covariance of the S matrix and the existence of a unique representation of the IHLG to be associated with the relativistic 2-particle system. The connection between the Lie algebra, the covariant form of the S matrix, and the uniqueness of K, the generator of pure Lorentz transformations, is thereby clarified. The extension of these considerations to include bound states is made. (Contractor's abstract, in part)

1418

Maryland U. Dept. of Physics and Astronomy, College Park.

THE φ-ω MIXING ANGLE, by Y. S. Kim, S. Oneda, and J. C. Pati. [1964] [4]p. incl. table, refs. (AFOSR-65-0500) (AF AFOSR-64-500) AD 614171
Unclassified

Also published in Phys. Rev., v. 135: B1076-B1079, Aug. 24, 1964.

Under the assumption of vector-meson dominance for $\pi^0 \to 2\gamma$, $\omega \to 3\pi$, and $\varphi \to \rho + \pi$, the φ-ω mixing angles from the observed decay rates for these processes was obtained. These mixing angles are smaller than the Okubo-Sakurai value derived from the Gell-Mann-Okubo mass formula for the vector-meson octet. The lower mixing angles obtained correspond to only a small viola-

tion (less than 10%) of the mass-square formula. Further possible checks on these mixing angles, as well as on the hypothesis of φ-ω mixing and the vector-meson dominant model are discussed. (Contractor's abstract)

1419

Maryland U. Dept. of Physics and Astronomy, College Park.

SU(3) SYMMETRY AND THE NONLEPTONIC K-MESON PROCESSES, by S. Oneda, Y. S. Kim, and D. Korff. [1964] [10]p. incl. diagrs. refs. (AFOSR-65-0501) (AF AFOSR-64-500) AD 614172
Unclassified

Also published in Phys. Rev., v. 136: B1064-B1073, Nov. 23, 1964.

Consequence of the SU(3) octet scheme for the non-leptonic weak interactions are studied in some of the non-leptonic K-meson processes. The K_1^0-K_2^0 mass difference and the rates of $K_2^0 \to 2\gamma$ and $K_2^0 \to \pi^+ + \pi^- + \gamma$ decays are discussed. The effect of ω-φ mixing is considered in the $K_2^0 \to 2\gamma$ decay. The possible violation of the $|\Delta I| = \frac{1}{2}$ rule in the $K_2^0 \to 3\pi$ decay is discussed in terms of the η-meson pole contribution. The characteristic features of $K^+ \to \pi^+ + \pi^0 + \gamma$ and $K^+ \to 3\pi$ decays in our model are also discussed. It is inferred that the rate of $K^+ \to \pi^+ + \pi^0 + \gamma$ decay is dominated by the internal bremsstrahlung contribution. A possible effect of a unitary singlet pseudoscalar meson on these problems is also discussed. (Contractor's abstract)

1420

Maryland U. Dept. of Physics and Astronomy, College Park.

THREE-PARTICLE UNITARITY INTEGRAL, by Y. S. Kim. [1964] [5]p. (AFOSR-65-0502) (AF AFOSR-64-500) AD 614173
Unclassified

Also published in Phys. Rev., v. 135: B454-B458, July 27, 1964.

Various forms of the production amplitude are proposed which are convenient for the 3-particle unitarity integral. Both exact and approximate forms are discussed. It is found that in both cases one can separate the final-state configuration from the over-all kinematics by using discrete variables. Form factors with the 3-particle intermediate state are also discussed. (Contractor's abstract)

1421

Maryland U. Dept. of Physics and Astronomy, College Park.

REMARKS ON STRANGENESS NON-CONSERVING WEAK LETPONIC INTERACTIONS, by S. Oneda. [1964] [7]p. incl. refs. (AFOSR-65-0504) (AF AFOSR-64-500) AD 614174
Unclassified

Also published in Nuclear Phys., v. 57: 89-95, Aug./Sept. 1964.

The possibility that both the leptonic currents and the vector K-π resonance, M, couple with the same strangeness changing currents is discussed. The magnitude of renormalized coupling constant and the form factors of $K_{\mu 3}$-decay are discussed. A reasonable consistency with the present experimental situations with regard to the leptonic strangeness changing processes and to the K-π resonances is indicated. (Contractor's abstract)

1422

Maryland U. Dept. of Physics and Astronomy, College Park.

UNITARY SYMMETRY AND NON-LEPTONIC K-DECAYS, by Y. S. Kim and S. Oneda. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-0505) (AF AFOSR-64-500) AD 614175   Unclassified

Also published in Phys. Ltrs., v. 8: 83-85, Jan. 1, 1964.

Current experimental data indicate that the unitary symmetry is a possible higher symmetry which contains in itself the charge independence of strong interactions. Higher symmetry schemes have been attempted also for the weak interaction. For non-leptonic weak processes, the $[\Delta I] = 1/2$ rule is a well accepted isospin selection rule. As the simplest generalization in which the $[\Delta I] = 1/2$ rule is built, it is assumed that the weak non-leptonic interaction Hamiltonian, together with the pseduoscalar and the vector mesons, belongs to the SU(3) octet. Some experimental implications of this assumption in various K-decay processes is discussed.

1423

Maryland U. Dept. of Physics and Astronomy, College Park.

DYNAMICAL MODEL OF THE 1535-MEV Ξ^* HYPERON, by J. C. Pati. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-0506) (AF AFOSR-64-500) AD 614176   Unclassified

Also published in Phys. Rev., v. 134: B387-B396, Apr. 27, 1964.

An attempt is made to understand the dynamical origin of the 1535-mev Ξ^* hyperon. The problem of scattering in the J = 3/2$^+$ state of the $\bar{K}\Lambda$ channel is studied by the N/D method. The influence of all other channels are ignored. The dynamical singularities of the partial-wave amplitude are assumed to arise mainly from the near cut due to the nucleon exchange in the crossed channel, and from the far left-hand cut, i. e., $\infty < S \leq 0$. The contribution of the former is evaluated explicitly in terms of the ΛNK coupling constant and that of the latter, by the method of Balazs, through the introduction of the effective range-pole terms.

1424

Maryland U. Dept. of Physics and Astronomy, College Park.

COUPLING OF INTERNAL AND SPACE-TIME SYMMETRIES, by O. W. Greenberg. [1964] [4]p. (AFOSR-65-0507) (AF AFOSR-64-500) AD 614181   Unclassified

Also published in Phys. Rev., v. 135: B1447-B1450, Sept. 21, 1964.

When Lorentz invariance is ignored, internal symmetries which are violated in a given way, and which are independent of the space-time symmetries, can be rewritten in terms of a larger group which contains the internal group and the time-translation group in a coupled, noncommuting way. This rewriting can be chosen so that the noncommutativity of the time-translation and internal groups splits the mass degeneracy of internal multiplets, i.e., accounts for what was previously called "violation" of the internal group. This procedure is illustrated explicitly for the SU(3) baryon octet with octet symmetry violation. When Lorentz invariance is required, the coupling of internal and space-time symmetries becomes more difficult.

1425

Maryland U. Dept. of Physics and Astronomy, College Park.

CHOICE BETWEEN PRIMARY AND DYNAMICAL $|\Delta T| = 1/2$ RULE IN THE CURRENT-CURRENT PICTURE FOR NONLEPTONIC WEAK DECAYS, by J. C. Pati and S. Oneda. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-0826) (AF AFOSR-64-500) AD 616467   Unclassified

Also published in Phys. Rev., v. 136: B1097-B1101, Nov. 23, 1964.

The P-wave intrinsic structure of K $\to$ 3π decays is studied in the current-current picture for nonleptonic weak interactions, and it is shown that an accurate measurement of the asymmetry parameters of K $\to$ 3π decays could distinguish whether or not the $|\Delta T| = 1/2$ rule is primary or dynamical. In case of the former, as is expected, not only the rates, but also the asymmetry parameters of K $\to$ 3π decays should be consistent with a dominant $|\Delta T| = 1/2$ rule, while for the latter, one should expect to observe a large violation of the $|\Delta T| = 1/2$ rule in the asymmetry parameters of K $\to$ 3π decays with or without a similar violation in the rates. Some comments are made concerning the general necessity of enhancement of nonleptonic modes regardless of whether the $|\Delta T| = 1/2$ rule is primary or dynamical. (Contractor's abstract)

1426

Maryland U. Dept. of Physics and Astronomy, College Park.

ON A CLASS OF THIRRING MODELS, by C. S. Lam.

[1964] [8]p. incl. refs. (AFOSR-66-0440) (AF AFOSR-64-500) AD 630233   Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 637-644, Nov. 1, 1964.

A class of Thirring models self-coupled through a non-covariant current operator is investigated. It is shown that such a coupling will lead to physically meaningful results only at a fixed coupling strength. Furthermore, symmetry-breaking solutions of a kind to be specified in the text are permissible only at this particular coupling strength. The question of Goldstone zero-mass bosons is discussed. (Contractor's abstract)

1427

Maryland U. Dept. of Physics and Astronomy, College Park.

GAUGE PROBLEMS IN CANONICALLY QUANTIZED ELECTRODYNAMICS WITHOUT SUBSIDIARY CONDITIONS, by C. S. Lam. Aug. 1964, 41p. (Technical rept. no. TR-397) (AF AFOSR-64-500) AD 623850   Unclassified

Relations between time ordered functions of quantum electrodynamics quantized in different gauges are discussed.

1428

Maryland U. Dept. of Physics and Astronomy, College Park.

TRANSPORT THEORY FOR ELECTRON-PHONON INTERACTIONS IN METALS, by R. E. Prange. [1964] [15]p. incl. refs. (AFOSR-66-1300) (AF AFOSR-65-735) AD 641096   Unclassified

Also published in Phys. Rev., v. 134: A566-A580, May 4, 1964.

By extending Migdal's approximation for electron-phonon interactions in metals to the nonequilibrium case, it is possible to derive a set of transport equations which are exact to order $(m/M)^{1/2}$. The transport equations may be written in two different forms: In the first form, the electronic distribution function is labeled by a momentum vector; in the second, the labels are excitation energy and the position on the Fermi surface. Despite the width in the spectrum, the momentum space form is identical with the Landau quasiparticle theory. The energy space form is slightly simpler because no wave function renormalization constants appear in the definition of the energies or in the scattering matrix elements. In fact, in the case in which there is space dependence but no time dependence this form of the transport equations looks identical to the weak-coupling Boltzmann equations. This identity is used to prove that to the accuracy of the adiabatic approximation the several transport coefficients are completely unchanged by the many-body effects of the electron phonon interaction. These coefficients, which include the spin diffusivity and the viscosity as well as the ordinary conductivities and all the classical galvano-

magnetothermal effects are thus correctly predicted by the standard weak-coupling theory. (Contractor's abstract)

1429

Maryland U. Dept. of Physics and Astronomy, College Park.

SUPERCONDUCTIVITY IN A STRONG SPIN-EXCHANGE FIELD, by P. Fulde and R. A. Ferrell. [1964] [14]p. incl. diagrs. refs. (AFOSR-67-0126) (AF AFOSR-65-735)   Unclassified

Also published in Phys. Rev., v. 135: A550-A563, Aug. 3, 1964.

A strong exchange field, such as produced by ferro-magnetically aligned impurities in a metal, will tend to polarize the conduction electron spins. If the metal is a superconductor, this will happen only if the spin-exchange field is sufficiently strong compared to the energy gap. When the field is strong enough to break many electron pairs, the self-consistent gap equation is modified and a new type of depaired superconducting ground state occurs. In the idealization of a spatially uniform exchange field ith no scattering, it is found that the depaired state has a spatially dependent complex Gorkov field, corresponding to a nonzero pairing momentum in the BCS model. The presence of the "normal" electrons from the broken pairs reduces the total current to zero, gives the depaired state some spin polarization, and results in almost normal Sommerfeld specific heat and single-electron tunneling characteristics. The nonzero value of the pairing momentum also gives rise to an unusual anisotropic electrodynamic behavior of the superconductor, as well as to a degenerate ground state and low-lying collective excitations, in accordance with Goldstone's theorem. (Contractor's abstract, modified)

1430

Maryland U. [Dept. of Physics and Astronomy] College Park.

CRITICAL CURRENT AND ELECTRON DEPAIRING IN SUPERCONDUCTING FILMS, by P. Fulde and R. A. Ferrell. [1963] [3]p. incl. diagrs. (AFOSR-67-0166) (AF AFOSR-65-735)   Unclassified

Also published in Phys. Rev., v. 131: 2457-2459, Sept. 15, 1963.

By varying the magnetic flux enclosed by a cylindrical superconducting film, a supercurrent can be induced to flow in the film. A maximum in the current is reached at a certain value of flux, beyond which the current gradually decreases as a result of the breakup of electron pairs. The self-inductance of the cylinder prevents, however, the experimental study of the depairing situation. This difficulty can be overcome by filling the hollow cylinder with another superconductor whose Meissner effect reduces the flux linkage and the self-inductance of the film. This method of stabilizing the electron depairing should make possible the confirmation of both the following effects of pair breakup:

(a) almost normal tunneling current for voltages less than the gap voltage; (b) anisotropic-electromagnetic surface impedance of the supercurrent-carrying film. (Contractor's abstract)

1431

Maryland U. [Dept. of Physics and Astronomy] College Park.

SELF-FIELD LIMITING OF JOSEPHSON TUNNELING OF SUPERCONDUCTING ELECTRON PAIRS, by R. A. Ferrell and R. E. Prange. [1963] [3]p. incl. diagrs. (AFOSR-67-0170) (AF AFOSR-65-735) Unclassified

Also published in Phys. Rev. Ltrs., v. 10: 479-481, June 1, 1963.

The action of the self-induced magnetic field on the Josephson current carried by pairs of superconducting electrons tunneling through an insulating barrier between two superconductors is considered. The calculation shows that in a barrier whose smallest diameter is greater than a penetration distance λ_J, the Josephson current arises only from a fringe of width λ_J at the barrier edges. For typical junctions λ_J is estimated to be of the order of one half a mm.

1432

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON HARMONIC FUNCTIONS OF FOUR VARIABLES WITH RATIONAL o_4- ASSOCIATES, by R. P. Gilbert. [1963] [18]p. (AFOSR-2252) (AF 49(638)228) AD 419694　　　　　　　　Unclassified

Also published in Pacific Jour. Math., v. 13: 79-96, 1963.

The solution of the four dimensional Laplace equation, Operator H is identical to the summation from $\nu = 1$ to 4 of $(H_{x_\nu} x_\nu = 0)$, are investigated by means of the integral operator approach the operator which transforms analytic functions of three complex variables into solutions is used.

1433

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

APPLICATION OF THE TWO-PARTICLE DISTRIBUTION FUNCTION TO ESTIMATE THE COLLISIONAL DAMPING OF PLASMA OSCILLATIONS, by J. M. Burgers. [1963] [9]p. (AFOSR-J1235) (AF 49(638)401) AD 424353　　　　　　　　Unclassified

Also published in Phys. Fluids, v. 6: 889-897, July 1963.

An approximate, linearized equation for the pair corre-

lation function, containing a Debye potential instead of the Coulomb potential, is used to derive by direct integration a solution for the pair correlation function for the case of long-wavelength plasma oscillations in a fully ionized gas without a magnetic field. The correlation function is then applied to describe the effect of collisions in a linearized Boltzmann equation for the single-particle distribution function, which again is integrated directly. By substituting the integral of the single-particle function over the velocity space into Poisson's equation for the electric field, a dispersion equation is constructed for the oscillations. From this dispersion equation the damping of the oscillations can be found. The result combines the Landau damping with the collisional damping.

1434

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

DETAILED FLOW-FIELD OBSERVATIONS IN THE TRANSITION PROCESS IN A THICK BOUNDARY LAYER, by E. R. Hama and J. Nutant. [1963] [17]p. incl. illus. diagrs. refs. (AFOSR-J847) (AF 49(638)645) AD 416384　　　　　　　　Unclassified

Also published in Proc. 1963 Heat Transfer and Fluid Mechanics Inst., ed. by A. Roshko, B. Sturtevant, and D. R. Bartz. Stanford U. Press, 1963, p. 77-93.

Detailed flow-field observations are made of the transition process in a boundary layer of approx 1 in. thickness in a long running-water channel by the use of the pulsed hydrogen-bubble visualization technique. Following the amplification of the originally two-dimensional wave, the wave warps its front acquiring a longitudinal vorticity component along its swept-back front. The longitudinal vorticity component becomes rapidly concentrated to form a Λ-shaped vortex but with its tip open. This primary Λ vortex creates a strong upward fluid motion along and inside its legs and a high-shear layer is formed. (Contractor's abstract, modified)

1435

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE GENERATION OF SECONDARY MOTIONS IN THE FIELD OF A VORTEX, by J. R. Weske and T. M. Rankin. Mar. 1963 [25]p. incl. illus. diagrs. refs. (Technical note BN-313) (AFOSR-4666) (AF AFOSR-62-230) AD 410107　　　　　Unclassified

Also published in Phys. Fluids, v. 6: 1397-1403, Oct. 1963.

The investigation is concerned with motions in the region of the core of a vortex which exhibit peripheral vorticity. From theoretical reasoning it appears that development of such motions is favored as a zonal maximum of axial vorticity components is produced; e. g. by divergence of the vortex core. Several experiments devised to verify theoretical conclusions furnish evidence

that concentrations of vorticity periodic about the perimeter actually do occur as expected. (Contractor's abstract)

1436

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

UPPER AND LOWER BOUNDS FOR THE APSIDAL ANGLE IN THE THEORY OF THE HEAVY SYMMETRI-CAL TOP, by J. B. Diaz and F. T. Metcalf. [1964] [17]p. incl. diagrs. (AFOSR-64-2417) (AF AFOSR-62-454) AD 453614   Unclassified

Also published in Arch. Rational Mech. and Anal., v. 16: 214-229, 1964.

If one considers the constrained motion of a particle on the surface of a sphere, solely under the external influence of gravity, this motion may be shown, under certain circumstances, to take place between two horizontal planes cutting the surface. The particle moves periodically from one level to the other and then back again. The position of the particle is given by specifying two quantities, the azimuthal angle and the vertical height. The azimuth is defined to be the angle between the horizontal projection of the position vector and the same projection at some initial time. As the particle moves from the lowest level of motion to the highest, the corresponding increase in the azimuth is called the apsidal angle. A similar situation occurs in the theory of the heavy symmetrical top. A point fixed on the axis of symmetry moves on a sphere and executes a periodic motion between two horizontal planes. Again an apsidal angle may be defined.

1437

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

APPROXIMATION OF DERIVATIVES BY FINITE DIFFERENCE METHODS IN ELLIPTIC BOUNDARY VALUE PROBLEMS, by J. H. Bramble and B. E. Hubbard. [1964] [12]p. incl. refs. (AFOSR-65-0327) (AF AFOSR-62-454) AD 612435   Unclassified

Also published in Contrib. Differential Equations, v. 3: 399-410, 1964.

The problem is considered of approximating the solution of the Dirichlet problem for $Lu = au_{xx} + 2bu_{xy} + cu_{yy} + du_x + eu_y + fu = F$ in a connected region R with smooth boundary C in the (x, y)-plane, where $|b| < a$, c; $f < 0$ and the coefficients and data are smooth. Results are obtained for problems in this class which have solutions with bounded fifth derivatives.

1438

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

ON MEAN VALUE THEOREMS FOR STRONGLY CON-TINUOUS VECTOR VALUED FUNCTIONS, by J. B. Diaz and R. Vyborny. [1964] [12]p. (AFOSR-64-1734) (AF AFOSR-63-400) AD 447592   Unclassified

Also published in Contrib. Differential Equations, v. 3: 107-118, 1964.

The purpose of this note is to prove two mean value theorems for strongly continuous vector valued functions, which are generalizations of the mean value theorem for strongly continuous and strongly differentiable functions.

1439

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

A MEAN VALUE THEOREM FOR STRONGLY CON-TINUOUS VECTOR VALUED FUNCTIONS, by J. B. Diaz and R. Vyborny. [1964] [2]p. (AFOSR-64-1826) (AF AFOSR-63-400) AD 449062   Unclassified

Also published in Czechoslovak Math. Jour., v. 14: 322-323, 1964.

For abstract see item no. 1438, Vol. VII.

1440

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

BERGMAN'S INTEGRAL OPERATOR METHOD IN GENERALIZED AXIALLY SYMMETRIC POTENTIAL THEORY, by R. P. Gilbert. [1964] [15]p. (AFOSR-64-2325) (AF AFOSR-63-400) AD 452321   Unclassified

Also published in Jour. Math. Phys., v. 5: 983-997, July 1964.

This paper contains a study of properties of solutions to the equation of generalized axially symmetric potentials. These potentials play an important role in many aspects of mathematical physics, in particular to an understanding of compressible flow in the transonic region. The ideas that have been basic in this investigation are contained in the integral operator method of Bergman. This method allows one to transplant certain properties of analytic functions to the solutions of linear partial differential equations. Results are obtained concerning singularities, residues, bounds, and growth of entire solutions, which are analogous to those found in classical function theory.

1441

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

VELOCITY MODULATION OF A RELATIVISTIC ELECTRON BEAM, by P. C. T. DeBoer. [1964] [4]p. (AFOSR-65-0923) (AF AFOSR-64-141) AD 613908   Unclassified

Also published in Jour. Appl. Phys., v. 35: 2789-2792, Oct. 1964.

Velocity modulation of a 1-dimensional electron beam is treated relativistically, starting from the collisionless Boltzmann equation and using first-order perturbation theory. A general expression for the perturbation current density j_1 is applied first to a mono-energetic unperturbed beam. Compared to the nonrelativistic case, the magnitude of j_1 is reduced by the factor $(1-u^2/c^2)^{3/4}$, where u is the unperturbed beam velocity and c the velocity of light. The distance between the max of j_1 is increased by the inverse of the same factor. Relativistic effects decrease the efficiency of modulation η, which is defined as the energy carried by the electric field generated by the perturbations, divided by the energy flux in the unperturbed beam. For an unperturbed beam with a rectangular velocity distribution of narrow width w and a fixed mean velocity u_m, the results are independent of w to first order. Expressions for j_1 and η are also found for an unperturbed beam with a rectangular momentum distribution of arbitrary width. (Contractor's abstract, modified)

1442

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

EQUIVALENCE OF CERTAIN INEQUALITIES COMPLEMENTING THOSE OF CAUCHY-SCHWARZ AND HOLDER, by J. B. Diaz, A. J. Goldman, and F. T. Metcalf. [1964] [3]p. incl. refs. (AFOSR-65-0602) (AF AFOSR-64-400) AD 614158   Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 68B: 147-149, Oct.-Dec. 1964.

An inequality due to Diaz and Metcalf, which complements the Cauchy-Schwarz inequality, is shown equivalent to a result of Rennie. A more general inequality due to Diaz and Metcalf, which complements that of Holder, is proven equivalent to a previously published generalization of Rennie's inequality. (Contractor's abstract)

1443

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

ON A CLASS OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS IN FOUR VARIABLES, by R. P. Gilbert. [1964] [14]p. incl. refs. (AFOSR-65-1021) (AF AFOSR-64-400) AD 618353   Unclassified

Also published in Pacific Jour. Math., v. 14: 1223-1236, 1964.

The elliptic partial differential equation,

$$T_3[\Psi] = \frac{\partial^2 \Psi}{\partial x_\mu \partial x_\mu} + A(r^2) x_\mu \frac{\partial \Psi}{\partial x_\mu} + C(r^2) \Psi = 0, \ (\mu = 1, 2, 3)$$

has been considered by S. Bergman. This paper investigates the 4 variable analogue of this equation, $T_4[\Psi] = 0$, and shows that many of Bergman's results carry over to this case. In many instances, the methods of several complex variables are needed in order to find the natural generalizations. An integral operator, $B_4[f]$, is used to study the solutions of the above equations. $B_4[f]$ maps analytic functions of 3-complex variables onto harmonic, function-elements of 4 variables.

1444

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

COMPLEMENTARY INEQUALITIES IV: INEQUALITIES COMPLEMENTARY TO CAUCHY'S INEQUALITY FOR SUMS OF COMPLEX NUMBERS, by J. B. Diaz and F. T. Metcalf. [1964] [38]p. incl. diagr. (AFOSR-66-1232) (AF AFOSR-64-400) AD 641723   Unclassified

Also published in Rend. Circ. Matem. Palermo, Series II, v. 13: 1-38, 1964.

Several inequalities, complementary to Cauchy's inequalities are proved for complex numbers. These provide lower bounds, and are extensions from complementary inequalities for real numbers. Several ring theorems are proved to establish immediate analogs.

1445

Maryland U. Inst. of Molecular Physics, College Park.

STUDIES OF COLOR CENTERS IN ALKALI HALIDES, by W. G. Maisch. Final rept. Sept. 1963, 1v. (AFOSR-J1159) (AF 49(638)627) AD 423984
                    Unclassified

The peak energy of the F band in the alkali halides studied is very sensitive to changes in the lattice spacing. High pressure measurements indicate that the Ivey equation is fortuitous in that the peak energy is not uniquely determined by the interionic distance of the bulk crystal, but also depends upon the host crystals. Half-widths of the F band above the transition point were greater than below the transition point and the peak optical density decreased. Absorption spectra of the F and M centers in RbF, RbCl, RbBr, and CsI were investigated as a function of pressure. In addition to the F and M band, the No. 3 band and some other unidentified bands were observed under pressures up to 10,000 atm for the absorption spectra of RbCl and RbBr and up to 50,000 atm for the absorption spectra of RbF and CsI.

1446

Massachusetts Inst. of Tech., Cambridge.

NONEQUILIBRIUM IONIZATION DUE TO ELECTRON
HEATING: II. EXPERIMENTS, by J. L. Kerrebrock
and M. A. Hoffman. [1964] [8]p. incl. diagrs. table,
refs. (AFOSR-64-0583) (AF AFOSR-62-308)
Unclassified

Presented at AIAA Aerospace Sciences Meeting, New
York, Jan. 20-22, 1964.

Also published in AIAA Jour., v. 2: 1080-1087, June
1964.

An experimental study has been conducted of nonequi-
librium conductivity of mixtures of argon and potassium.
A pure plasma is produced in thermal equilibrium at
temperatures up to 2500°K by means of a steady-flow
tantalum heat exchanger. Conductivity measurements
made with probes between the electrodes indicate that
the two-temperature conduction law proposed is valid
for electron concentrations above about $10^{13}/cm^3$. At
lower electron concentrations, the theory is in error,
probably because the electron energy distribution is
very non-Maxwellian. (Contractor's abstract, modified)

1447

Massachusetts Inst. of Tech., Cambridge.

NONEQUILIBRIUM IONIZATION DUE TO ELECTRON
HEATING: I. THEORY, by J. L. Kerrebrock. [1964]
[9]p. (AFOSR-64-2017) (AF AFOSR-62-308)
AD 451198 Unclassified

Also published in AIAA Jour., v. 2: 1072-1080, June
1964.

A two-temperature conduction law is proposed which
accounts for the variation of the electrical conductivity
of a plasma due to joule heating of the electrons. The
process of relaxation from an initial condition of thermal
equilibrium to the final nonequilibrium condition is
treated for a channel flow that represents conditions in
an MHD generator. For a mixture of argon and potas-
sium at 1 atm pressure and 2000°K, the relaxation
length is about 1 m at a Mach number of unity if the elec-
tric field is held constant. The stability of the two-
temperature plasma to wavelike disturbances of electron
energy and concentration is treated by the classical per-
turbation technique.

1448

Massachusetts Inst. of Tech. Aeroelastic and Structures
Research Lab., Cambridge.

RESEARCH ON AEROTHERMOELASTICITY, by J.
Dugundji. Final summary rept. June 15, 1963, 12p.
incl. refs. (AFOSR-5148) (AF 49(638)219) AD 411292
Unclassified

The general effects of aerodynamic heating on the aero-
elastic properties of flight vehicles are investigated.

Attention was directed toward coupling mechanisms
between aeroelastic and heating effects. Six specific
projects were investigated: (1) thermal stress effects
in aeroelastic models, (2) vibration and flutter of conical
and cylindrical shells, (3) aeroelastic properties of
heated, low aspect ratio wings, (4) subsonic flutter of
panels on continuous elastic foundations, (5) flutter of
orthotropic plates, and (6) local dynamic effects attend-
ant to leading edge melting and ablation.

1449

Massachusetts Inst. of Tech. Aeroelastic and Structures
Research Lab., Cambridge.

SUPERSONIC FLUTTER OF RECTANGULAR ORTHO-
TROPIC PANELS WITH ARBITRARY ORIENTATION OF
ORTHOTROPICITY, by J. M. Calligeros and J.
Dugundji. June 1963, 78p. incl. diagrs. refs. (ASRL
technical rept. 74-5) (AFOSR-5328) (AF 49(638)219)
AD 421977 Unclassified

An investigation is made of the supersonic flutter of flat,
simply supported, rectangular, orthotropic panels,
utilizing small deflection thin plate theory and piston
theory aerodynamics. Stability boundaries are obtained
showing the effects of rotating the panel principal axes
with respect to the geometric axes. The role of damping
and the effects of panel length-width ratio are also ex-
amined. Solutions are obtained using the Principle of
Minimum Potential Energy together with a sixteen-mode
Rayleigh-Ritz procedure. It is concluded that aligning
stiffeners parallel to the air stream direction is not
always the preferred orientation. (Contractor's abstract,
modified)

1450

Massachusetts Inst. of Tech. Aeroelastic and Structures
Research Lab., Cambridge.

PLASTIC DEFORMATION AND FAILURE OF SILVER-
STEEL FILAMENTARY COMPOSITE MATERIALS, by
H. R. Piehler. Nov. 1963, 18p. (ASRL-TR-94-5)
(AF 49(638)775) AD 426348 Unclassified

Continuous 7 and 19 filament close-packed silver-steel
filamentary composite materials were tested in tension.
The early stages of the composite plastic stress strain
curves followed a linear mixture rule constructed from
the properties of the individual components. The com-
posite elongations at failure, however, were about twice
the elongations observed when the filaments were tested
alone. The composite ultimate tensile strengths were
also above a mixture rule constructed from the ultimate
tensile stress of the filaments and the flow stress of the
matrix at a strain equal to the elongation at failure of the
filaments.

1451

Massachusetts Inst. of Tech. Aeroelastic and Structures
Research Lab., Cambridge.

NOTES ON BASIC RESEARCH ON STATIC AND

DYNAMIC NONLINEAR STRUCTURAL PROBLEMS, by
T. H. H. Pian, P. T. Hsu and others. Aug. 1963, 28p.
(ASRL-TR-109-1) (AFOSR-J1223) (AF AFOSR-62-239)
AD 424286   Unclassified

Static and dynamic, nonlinear, large-deflection struc-
tural problems have been studied. Both geometrical
nonlinearities, due to finite deformations of the struc-
ture, and physical nonlinearities due to plasticity, are
included in this investigation. The work is presented as
3 separate notes with the following titles: (1) Plane
stress yield condition for oblique coordinate systems;
(2) Instability of circular rings confined to a rigid bound-
ary; and (3) Numerical solutions for large deflections
and rotations of thin elastic-plastic spherical shells and
rings.

1452

Massachusetts Inst. of Tech. [Aeroelastic and Structures
Research Lab.] Cambridge.

NOTE ON THE INSTABILITY OF CIRCULAR RINGS
CONFINED TO A RIGID BOUNDARY, by P. T. Hsu, J.
Elkon, and T. H. H. Pian. [1964] [4]p. incl. diagrs.
(AFOSR-64-2238) (AF AFOSR-62-239) AD 452406
                                 Unclassified

Also published in Jour. Appl. Mech., Sept. 1964,
p. 559-562.

The present problem is concerned with the buckling of
a thin ring which is confined to a rigid circular boundary
and is subjected to an end-compressive load. The pur-
pose is to extend the study to include the effect of an
initial boundary imperfection.

1453

Massachusetts Inst. of Tech. Aerophysics Lab.,
Cambridge.

RESEARCH ON HEAT TRANSFER CHARACTERISTICS
OF DIFFUSION BOUNDARY LAYERS. Final rept.
May 1963, 14p. incl. refs. (AFOSR-5142) (AF 49-
(638)245) AD 411463   Unclassified

Studies are made on heat transfer characteristics of
diffusion boundary layers. Analyses of laminar and
turbulent layers undergoing injection at the boundary
were studied for the purpose of understanding the
effects of compressibility, pressure gradient, mixture
properties, and stability. Experimental investigations
were conducted to evaluate recovery temperature and
heat transfer rates, decay effects downstream of injec-
tion regions, ablation, geometries, etc. Methods
have been developed for so called nonsimilarity cases
and numerical results have been obtained for those with
similarity.

1454

Massachusetts Inst. of Tech. Aerophysics Lab.,
Cambridge.

AN EXPERIMENTAL STUDY OF THERMAL DIFFUSION
EFFECTS ON A PARTIALLY POROUS MASS TRANSFER-
COOLED HEMISPHERE, by A. F. Gollnick, Jr. [1964]
[10]p. incl. illus. diagrs. refs. (AFOSR-64-2233)
(AF 49(638)245) AD 452345   Unclassified

Also published in Internat'l. Jour. Heat and Mass
Transfer, v. 7: 699-708, 1964.

A hemispherical model having a porous nose cap of 40°
included angle was tested at Mach 3.07. Helium and
freon-13 were injected through the cap into the stagnation
region, and the variations of adiabatic wall temperature
and heat-transfer coefficient with injection rate were
measured. Analytical solutions have been obtained for
a laminar stagnation point boundary layer and similar
free stream conditions. The analysis differs from
earlier work in that the effects of thermal diffusion are
included. It is predicted that this thermodynamic
coupling may lead to stagnation point recovery tempera-
tures considerably different from the zero injection
value. (Contractor's abstract, modified)

1455

Massachusetts Inst. of Tech. Aerophysics Lab.,
Cambridge.

HIGH SPEED VISCOUS AND REACTING FLOWS. Final
rept. Apr. 1963-July 1964, 1v. (Rept. no. AL-TR-98;
DSR-9195) (AFOSR-64-1616) (AF AFOSR-62-407)
AD 605725   Unclassified

The objective of these investigations was to consider
several aspects of viscous and large temperature flow
fields. Overall topic groups are as follows: (1) the
mechanics of fluid injection for thermal protection;
(2) the role of thermal diffusion in boundary layer mix-
tures; (3) the evaluation of thermal diffusion coefficients
for turbulent conditions; and (4) the solution of radiation
coupled flows.

1456

Massachusetts Inst. of Tech. Center for International
Studies, Cambridge.

RADIO BROADCASTING IN COMMUNIST CHINA, by
A. P. L. Liu. June 1, 1964, 71p. incl. illus. diagrs.
tables, refs. (Rept. no. C/64-8) (AFOSR-67-0953)
(AF 49(638)1237)   Unclassified

This monograph deals with the rapid growth of a nation-
wide radio network in Communist China. It follows the
two major phases of development closely. The first
phase (1949-1955) was the development of a radio moni-
toring system when radio news was transmitted to the
public largely through trained monitors. The second
phase (1956-1963) was the development of a wired radio
network when loudspeakers were set up in villages all
over the country. The development of radio technology

is described, including training of personnel, control of equipment, content of broadcasting, and general listening habits. It is found that because of high illiteracy rates among the people and the controlled nature of broadcasting, the regime uses organized listening extensively with all the functional and dysfunctional consequences thereof.

1457

Massachusetts Inst. of Tech. Center for International Studies, Cambridge.

A GENERAL STUDY OF THE CHANNELS OF COMMUNICATION BETWEEN COMMUNIST CHINA AND THE WESTERN WORLD, by V. V. S. King. May 1, 1964, 94p. incl. tables, refs. (Rept. no. C/64-9) (AFOSR-67-0954) (AF 49(638)1237)   Unclassified

This paper is a general survey of all major media about foreign countries existing in Communist China. first describes the regular mass media (press, periodicals, and radios) and analyzes their content with emphasis on foreign news. Then a special case study is done—the Cuban Missile Crisis—to see how major Chinese newspapers handled the event. It also describes the special agencies in China dealing with foreign trade and cultural exchanges. Statistical information is presented about Chinese delegations sent abroad and foreign delegations coming to China from 1959 to 1961, number of foreign exhibits in China from 1958 to 1962, and the number of foreign films shown in China. It is concluded that people in Communist China have a variety of sources of information about the outside world despite official control of information.

1458

Massachusetts Inst. of Tech. Center for International Studies, Cambridge.

SOVIET SOCIOLOGY: 1960-1963, by E. A. Weinberg. Oct. 1964, 110p. incl. tables, refs. (Rept. no. C/64-30) (AFOSR-67-0958) (AF 49(638)1237)   Unclassified

As Soviet sociology matures as a discipline, it becomes more receptive to Western scholarship, making increasing use of Western techniques and adapting them to Soviet research theory. According to Soviet scholars in the field, the main problem is a lack of coordination of research and poor communication among the various scholars and institutes engaged in research of a sociological nature. Lack of publishing facilities and inhibitions against experimentation also constitute difficulties, and remedies are suggested for their resolution. An evaluation is given of the state of Soviet sociology. It especially points to the lack of objectivity resulting from political considerations which precludes free choice and open dissent.

1459

Massachusetts Inst. of Tech. Computation Center, Cambridge.

ON THE STABILITY OF RATIONAL APPROXIMATION, by A. A. Goldstein. [1963] [8]p. incl. refs. (AFOSR-64-0718) (AF AFOSR-62-348) AD 436471
Unclassified

Also published in Numerische Math., v. 5: 431-438, 1963.

Let B denote a bounded map from ω to E_n and let $F(x) = \sup \{ |[A(\Phi), x]/[B(\Phi), x]) - b(\Phi)| : \Phi \in \omega$ and $[B(\Phi), x] > 0\}$. Let $D_1 = \{x \in E_n : [B(\Phi), x] > 0$ all $\Phi \in \omega\}$. Again in this setting it is known that F does not necessarily achieve a minimum on D_1. The idea of the present paper is to enlarge the domain D_1 to D as follows. Add those points to D_1 where numerator and denominator vanish simultaneously for some $\Phi \in \omega$. Then under mild hypotheses, algebraic in nature, F achieves a minimum on D at, say, y. As an application of this result the theorem of Achieser is deduced.

1460

Massachusetts Inst. of Tech. [Computation Center] Cambridge.

FUEL OPTIMIZATION IN ORBITAL RENDEZVOUS, by A. A. Goldstein, A. H. Greene, and A. T. Johnson. [1964] [22]p. incl. diagrs. refs. (AFOSR-64-1817) (AF AFOSR-62-348) AD 449070   Unclassified

Presented at AIAA Guidance and Control Conf., Cambridge, Mass., Aug. 12-14, 1963.

Also published in Guidance and Control, ed. by R. C. Langford and C. J. Mundo. New York, Academic Press, v. 2: 823-844, 1964.

This paper reports results of numerical investigations of certain thrust functions and the fuel expenditure they induce in the terminal phase of orbital rendezvous. Several criteria of optimality have been considered, and corresponding computer programs for each of these have been developed to calculate optimal controls. Numerical examples of controls thought to be optimal or nearly so, are exhibited. (Contractor's abstract)

1461

[Massachusetts Inst. of Tech. Computation Center, Cambridge]

CONVEX PROGRAMMING IN HILBERT SPACE, by A. A. Goldstein. [1964] [2]p. (AFOSR-64-2424) (AF AFOSR-62-348) AD 453531   Unclassified

Also published in Bull. Amer. Math. Soc., v. 70: 709-710, Sept. 1964.

This note gives a construction for minimizing certain

twice-differentiable functions on a closed convex subset C, of a Hilbert Space, H. The algorithm assumes one can constructively "project" points onto convex sets. In certain instances, say on spheres, linear varieties, and orthants, the method can be effective for applications to control theory.

1462

Massachusetts Inst. of Tech. Computation Center, Cambridge.

DUALITY THEOREMS FOR CONVEX FUNCTIONS, by R. T. Rockafellar. [1964] [4]p. (AFOSR-64-2552) (AF AFOSR-62-348) AD 454021   Unclassified

Also published in Bull. Amer. Math. Soc., v. 70: 189-192, Jan. 1964.

The purpose of this note is to announce the following general fact: Let F and G be finite-dimensional partially-ordered real vector spaces in which the non-negative cones P(F) and P(G) are polyhedral. Let A be a linear transformation from F to G. Let f be a proper convex function on F and let g be a proper concave function on G. If there exists at least one $x \in ri$ (dom f) such that $x \geq 0$ and $Ax \geq y$ for some $y \in ri$ (dom g), then

$$\inf \{f(x) - g(y) \mid x \geq 0, Ax \geq y\}$$
$$= \max \{g^*(y^*) - f^*(x^*, ; y^* \geq 0, A^*y^* \leq x^*\},$$

where A* is the adjoint of A.

1463

Massachusetts Inst. of Tech. [Computation Center] Cambridge.

BEST APPROXIMATION WITH RESPECT TO NEARBY NORMS, by B. R. Kripke. [1964] [3]p. (AFOSR-65-0324) (AF AFOSR-62-348) AD 612222
                               Unclassified

Also published in Numerische Math., v. 6: 103-105, 1964.

The following theorem is established. Let V be a vector space of finite dimension, W a subspace of V, $f \in V$. Let ρ_k, $k = 1, 2, \ldots$, be seminorms on V such that for each $v \in V$, $\lim_{k \to \infty} \rho_k(v) = \rho(v)$, where o is a norm. Let $\rho_k \in W$ be the best ρ_k-best approximation to f. Then (1) every subsequence of $\{\rho_k\}$ has a ρ-convergent subsequence; (2) $o(f - \rho_k) \to \inf \{\rho(f - w) \mid w \in W\}$; (3) every ρ-cluster point of $\{\rho_k\}$ is a ρ-best approximation to f; and (4) if f has a unique ρ-best approximation ρ out of W, then $\rho (\rho - \rho_k) \to 0$.

1464

[Massachusetts Inst. of Tech. Computation Center, Cambridge]

A NECESSARY CONDITION FOR THE EXISTENCE OF

BEST APPROXIMATIONS, by B. R. Kripke and R. T. Rockafellar. [1964] [2]p. (AFOSR-65-1005) (AF AFOSR-62-348) AD 618620   Unclassified

Also published in Jour. Math. and Mech., v. 13: 1037-1038, Nov. 1964.

This note proves the following theorem: Let B be a Banach space and X a bounded subset of B. In order that for each bounded real-valued function F on X there exist a continuous linear functional $\emptyset \in B^*$ such that $\Delta(\emptyset) = \sup \{|F(x) - \emptyset(x)|: x \in X\} = \inf \{\Delta(\phi): \phi \in B^*\}$, it is necessary that 0 be in the interior of the closed, balanced, convex hull K of X relative to its linear span [K]. It was formerly proved that this condition is also sufficient to insure the existence of best approximations even when X is not bound. This paper shows that when the condition fails, there is a linear function F on [K] such that the restriction of F to X is continuous, and F can be uniformly approximated on X within any desired degree of accuracy by functionals in B*, but the restriction of F to X is not equal to the restriction to X of any function.

1465

Massachusetts Inst. of Tech. [Computation Center] Cambridge.

NUMERICAL SOLUTION OF MULTI-GROUP EQUATIONS, by K. F. Hansen and D. R. Edwards. [1963] [2]p. (AFOSR-64-2129) (AF AFOSR-63-341) AD 452028   Unclassified

Also published in Trans. Amer. Nuclear Soc., June 1963, p. 10-11.

This paper presents a new method for numerically solving the multi-group equations. The method was first presented in connection with the Helmholtz equation. The current report represents a generalization and extension of the original work.

1466

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

THE FLUTTER OF MULTI-BAY PANELS AT HIGH SUPERSONIC SPEEDS, by E. Dowell. Aug. 1963, 110p. incl. diagrs. refs. (ASRL-TR-112-1) (AFOSR-5327) (AF AFOSR-62-363) AD 423929
                               Unclassified

Presented at AIAA Aerospace Sciences Meeting, New York, Jan. 20-22, 1964.

Also published in AIAA Jour., v. 2: 1805-1814, Oct. 1964. (AFOSR-64-2474; AD 609812)

The flutter of 2-dimensional panels of finite and infinite length on multiple simple supports in the streamwise direction was investigated theoretically under the assumptions that the system is adequately described by classical small deflection plate theory and

quasi-steady, supersonic aerodynamic theory. No
further physical and/or mathematical approximations
are made and a solution is effected by the method em-
ployed by Hedgepeth, Houbolt, and Movchan for the
one bay (2 supports) configuration. (Contractor's
abstract, modified)

1467

Massachusetts Inst. of Tech. [Dept. of Aeronautics
and Astronautics] Cambridge.

THE FLUTTER OF VERY LOW ASPECT RATIO
PANELS, by E. H. Dowell. July 1964, 93p. incl.
diagrs. refs. (ASRL-TR-112-2) (AFOSR-64-1723)
(AF AFOSR-62-363) AD 608702   Unclassified

The aeroelastic stability of an infinitely long panel of
finite width with the upper surface exposed to an in-
viscid flow is examined. The panel behavior is
accounted for by small deflection plate theory while the
aerodynamic forces acting on the panel are described
by the classical linearized, potential theory. The panel
is assumed to be simply-supported along the side edges,
although other edge conditions may be considered in a
similar manner. It is shown that the critical wavelength
is approximately twice the panel width and thus the
present results should be valid approximations for a
panel of finite length whose length is much greater than
its width. Rather extensive numerical results were ob-
tained for flutter velocity.

1468

Massachusetts Inst. of Tech. [Dept. of Aeronautics
and Astronautics] Cambridge.

MOLECULAR BEAM-SURFACE INTERACTIONS.
Final rept. 1964, 18p. (AFOSR-64-1661) (AF AFOSR-
63-131) AD 606078   Unclassified

The purpose of the work was to study the detailed
behavior of gas molecules at a solid boundary in order
to gain understanding of gas-solid collision phenomena.
Experimentally, the scheme involves analysis of the
velocity distribution of a beam of molecules incident on
a solid surface and analysis of velocity and spatial dis-
tribution of the molecules after surface collision. The
experimental work has thus far been directed towards
the development of: (1) a molecular velocity spectrome-
ter, (2) a vacuum apparatus, and (3) a signal detection
and discrimination system. The report includes pri-
marily a description of these components.

1469

Massachusetts Inst. of Tech. [Dept. of Aeronautics
and Astronautics] Cambridge.

EXPERIMENTS ON CYLINDER DRAG, SPHERE DRAG,
AND STABILITY IN RECTILINEAR COUETTE FLOW,
by D. L. Kohlman. Mar. 1963, 145p. incl. illus.
diagrs. tables, refs. (Fluid Dynamics Research Lab.
rept. no. 63-1) (AFOSR-4717) (AF AFOSR-62-187
and AF AFOSR-63-156) AD 400562   Unclassified

The purpose of this study was to develop an apparatus
for investigation of phenomena in rectilinear Couette
flow, and to conduct experiments in several such areas.
It was divided into 4 main parts: (1) Design and de-
velopment of the shear flow tank and related experi-
mental apparatus; (2) Study of circular cylinder drag in
Couette flow at low Reynolds number; (3) Study of sphere
drag in Couette flow at low Reynolds number; and (4)
Study of instability of rectilinear Couette flow. (Con-
tractor's abstract, modified)

1470

Massachusetts Inst. of Tech. [Dept. of Aeronautics
and Astronautics] Cambridge.

PARAMETRIC AMPLIFICATION OF SURFACE AND
INTERNAL WAVES, by R. E. Kelly. Final scientific
rept. June 1964, 113p. incl. illus. diagrs. refs.
(Fluid Dynamics Research Lab. rept. no. 64-3) (AFOSR-
64-1662) (AF AFOSR-63-156) AD 605728
                                Unclassified

The report concerns the possible signification of waves
in fluids due to fluctuations with time of some parameter
which defines in part the natural frequencies of the sys-
tem. First, the fluid is taken to be within a container
which oscillates in the vertical direction so that the
gravitational acceleration, relative to the container,
varies with time. Both surface waves, in the case of an
interface, and internal waves, in the case of continuous
variation of density, are considered. Secondly, two
fluids of different densities are taken to flow parallel
to each other in an oscillatory manner and with different
mean values of velocity. (Contractor's abstract, modi-
fied)

1471

Massachusetts Inst. of Tech. [Dept. of Aeronautics
and Astronautics] Cambridge.

STUDIES ON THE INSTABILITY OF CIRCULAR RINGS,
by Y. Elkon. June 1964, 52p. incl. diagrs. (ASRL-
TR-119-1) (AFOSR-64-1843) (AF AFOSR-63-347)
AD 609503   Unclassified

The critical loads associated with the instability phe-
nomenon of elastic-perfectly plastic circular rings,
which are confined to a rigid boundary and subjected to
end circumferential compressive loads, are determined.
Finite-deflection nonlinear theory is employed and two
types of imperfections are included in the model; (a)
boundary imperfection; (b) an imperfection in the shape
of the ring in its initially stress-free state. (Contrac-
tor's abstract, modified)

1472

Massachusetts Inst. of Tech. [Dept. of Aeronautics
and Astronautics] Cambridge.

DERIVATION OF ELEMENT STIFFNESS MATRICES

BY ASSUMED STRESS DISTRIBUTIONS, by T. H. H.
Pian. [1964] [4]p. incl. diagr. (AFOSR-64-2242)
(AF AFOSR-63-347) AD 452301   Unclassified

Also published in AIAA Jour., v. 2: 1333-1336, July
1964.

This paper presents an alternative derivation of the
element stiffness matrices. In this method, instead of
a required continuous displacement function over the
element, it is necessary only to write down the boundary
displacements that will guarantee a complete displace-
ment compatibility. The derivation is based on the
principle of minimum complementary energy. The
present proposed method is apparently different from
the variational methods suggested by Melosh and by
Best.

1473

Massachusetts Inst. of Tech. [Dept. of Aeronautics
and Astronautics] Cambridge.

LARGE ELASTIC, PLASTIC, AND CREEP DEFLEC-
TIONS OF CURVED BEAMS AND AXISYMMETRIC
SHELLS, by J. A. Stricklin, P.-T. Hsu, and T. H. H.
Pian. [1964] [8]p. incl. diagrs. refs. (AFOSR-64-
2243) (AF AFOSR-63-347) AD 452302 Unclassified

Presented at AIAA Aerospace Sciences Meeting,
New York, Jan. 20-22, 1964.

Also published in AIAA Jour., v. 2: 1613-1620, Sept.
1964.

A numerical method is presented for analyzing large
deflections of curved beams and large axisymmetric
deflections of shells of revolution. The governing
equations that are in finite-difference form are solved
by a Newton-Raphson iteration procedure. The plastic
stress-strain relations are determined by assuming
three independent slip planes that are the planes of
maximum shear stresses. The stress-strain relation
along each slip plane is assumed to be linearly strain
hardening. This plasticity model gives piecewise
linear plasticity relations with determinate coefficients.
The method is applied to several problems including low
arches, circular rings, shallow and deep spherical
shells under elastic-plastic deformations, and a shallow
arch under creep deformation. (Contractor's abstract,
modified)

1474

Massachusetts Inst. of Tech. [Dept. of Aeronautics
and Astronautics] Cambridge.

THE CALCULATION OF TWO- AND THREE-DIMEN-
SIONAL INVISCID UNSTEADY FLOWS BY THE
METHOD OF CHARACTERISTICS, by H. Sauerwein.
Final scientific rept. June 1964, 190p. incl. diagrs.
tables, refs. (Fluid Dynamics Research Lab. rept.
no. 64-4) (AFOSR-64-1055) (AF AFOSR-64-156)
AD 605324   Unclassified

The problem of the numerical solution by the method

of characteristics of the 2- and 3-dimensional flow of
an inviscid nonequilibrium gas is formulated. For un-
steady flows, the method is limited to the solution
of hypersonic or other flows which have short transient
times. The specific details of the finite difference net-
work and the associated finite difference equations are
presented. It was found that numerical instability was
possible with certain previously proposed networks. An
existing stability criterion was found to apply to the
multi-dimensional method of characteristics and the
criterion was used to synthesize a stable finite difference
network. High speed digital computer programs are
presented which perform the numerical calculation.
Four example cases of the flow about a circular cylinder
with its axis perpendicular to a Mach five free stream
are presented. (Contractor's abstract, modified)

1475

Massachusetts Inst. of Tech. [Dept. of Chemistry]
Cambridge.

CONCERNING THE MECHANISM OF THE REACTION
OF PHENYL(TRIHALOMETHYL)MERCURIALS WITH
OLEFINS, by D. Seyferth and J. M. Burlitch. [1964]
[2]p. (AFOSR-64-1802) (AF AFOSR-64-502)
AD 449087   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86:
2730-2731, July 5, 1964.

Studies of the stereochemistry of the haloformbutoxide-
olefin reaction and of the relative reactivities of olefins
toward this reagent system led to the conclusion that
the reaction of a free, electrophilic dihalocarbene with
the olefin was involved. Qualitative studies of relative
reactivities of olefins toward sodium trichloroacetate in
1, 2-dimethoxyethane suggested that there was also a
reaction between a free carbene and an olefin taking
place.

1476

Massachusetts Inst. of Tech. [Dept. of Mathematics]
Cambridge.

NON-RADIAL OSCILLATIONS AND CONVECTIVE IN-
STABILITY OF GASEOUS MASSES, by S. Chandrasekhar
and N. R. Lebovitz. [1963] [15]p. incl. table, refs.
(AFOSR-4609) (AF 49(638)42) AD 611734
Unclassified

Also published in Astrophys. Jour., v. 138: 185-199,
July 1, 1963.

Modes of non-radial oscillation of gaseous masses be-
longing to spherical harmonics of orders $l = 1$ and 3 are
considered on the basis of the first- and the third-order
virial equations. For an assumed Lagrangian displace-
ment the theory predicts the occurrence of modes of
oscillation of 2 different types: modes (belonging to $l = 3$) which are analogous to the Kelvin modes of an in-
compressible sphere and modes (belonging to $l - 1$)
which are analogous to those discovered by Pekeris for
a homogeneous compressible sphere and which exhibit
its convective instability. The theory is applied to the

polytropic gas spheres, and it is shown that they are convectively unstable.(for the modes belonging to $l = 1$) if the ratio of the specific heats γ is less than a certain critical value. The extent of this agreement is a measure of the accuracy of the method based on the virial equations and the assumed form of the Lagrangian displacement. (Contractor's abstract, modified)

1477

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

THE EQUILIBRIUM AND THE STABILITY OF THE JEANS SPHEROIDS, by S. Chandrasekhar and N. R. Lebovitz. [1963] [13]p. incl. diagrs. tables, refs. (AFOSR-4610) (AF 49(638)42) AD 611735
Unclassified

Also published in Astrophys. Jour., v. 137: 1172-1184, May 15, 1963.

The equilibrium and the stability of homogeneous masses distorted by the tidal effects of a secondary (of mass M' at a distance R) are re-examined on the basis of the second-order virial equations. In agreement with known results, it is shown that, under circumstances when the figure of equilibrium is a prolate spheroid, there is a maximum value of μ (= GM'/R^3) which is compatible with equilibrium. The problem of the small oscillations of these Jeans spheroids is next considered. The characteristic frequencies of oscillation belonging to the second harmonics are determined in case the mass is considered incompressible and in case it is considered compressible and subject to the gas laws governing adiabatic changes. (Contractor's abstract)

1478

Massachusetts Inst. of Tech. [Dept. of Mathematics, Cambridge.]

ON THE OSCILLATIONS OF THE MACLAURIN SPHEROID BELONGING TO THE THIRD HARMONICS, by S. Chandrasekhar and N. R. Lebovitz. [1963] [10]p. incl. diagrs. tables. (AFOSR-4611) (AF 49(638)42) AD 614155
Unclassified

Also published in Astrophys. Jour., v. 137: 1162-1171, May 15, 1963.

The characteristic frequencies of oscillation of the Maclaurin spheroid belonging to the third harmonics are found. Two further points of neutral stability, beyond the first at eccentricity $e = 0.81267$, are isolated. They occur at $e = 0.89926$ and $e = 0.96937$; it is the second of these that is the analogue of the point of bifurcation along the Jacobian sequence. (Contractor's abstract)

1479

Massachusetts Inst. of Tech. [Dept. of Mathematics, Cambridge]

ON THE STABILITY OF THE JACOBI ELLIPSOIDS, by S. Chandrasekhar and N. R. Lebovitz. [1963] [20]p. incl. diagrs. tables. (AFOSR-4612) (AF 49(638)42) AD 614156
Unclassified

Also published in Astrophys. Jour., v. 137: 1142-1161, May 15, 1963.

The problem of the small oscillations of the Jacobi ellipsoids is solved, and all the characteristic frequencies belonging to the second and the third harmonics are found. In particular, the variation, along the Jacobian sequence, of the characteristic frequency with respect to which the Jacobi ellipsoid becomes unstable is exhibited. (Contractor's abstract)

1480

[Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge]

A CLASSIFICATION THEOREM FOR FIBRE SPACES, by J. Stasheff. [1963] [8]p. incl. diagrs. (AFOSR-65-0078) (AF 49(638)42) AD 455619
Unclassified

Also published in Topology, v. 2: 239-246, 1963.

Let [X, Y] denote the set of homotopy classes of maps of X into Y, and LF(X) denote the set of fiber homotopy equivalence classes of Hurewicz fibrings p: E → X with fibers of the homotopy type of F. The following classification theorem is proved: If F is a finite CW-complex, there is a space B_H such that [, B_H] and LF( ) are naturally equivalent as functors from the category of CW-complexes and homotopy classes of maps to the category of sets and functions.

1481

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

SECTIONAL CURVATURES AND CHARACTERISTICS CLASSES, by J. A. Thorpe. [1964] [15]p. (AFOSR-65-0345) (AF 49(638)42) AD 612236
Unclassified

Also published in Ann. Math., v. 80: 429-443, Nov. 1964.

The relationship between the curvature properties of a Riemannian manifold X and the global topological and differential invariants of X is considered. The concept of pth sectional curvature is defined and examples presented.

1482

Massachusetts Inst. of Tech. [Dept. of Mathematics]
Cambridge.

A STRING PROBLEM, by H. P. Greenspan. [1963]
[10]p. (AFOSR-J1020) (AF 49(638)708) AD 419708
Unclassified

Also published in Jour. Math. Anal. and Appl., v. 6:
339-348, June 1963.

The forced oscillatory motion of a string of variable
length is considered. The primary aim is to examine
the response of this simple system to an excitation
which would produce resonance under slightly different
conditions (e. g., for a string of definite fixed length).
Interest in this problem derives from the fact that it may
be related to more complicated phenomena occurring in
hydrodynamic stability theory.

1483

Massachusetts Inst. of Tech. Dept. of Mathematics,
Cambridge.

RESEARCH IN FLUID DYNAMICS, by H. P. Greenspan.
Final rept. Sept. 16, 1960-Sept. 15, 1963, 3p. incl.
refs. (AFOSR-J1350) (AF 49(638)708) AD 619207
Unclassified

Research was conducted in the areas of wave propaga-
tion and shock dynamics, magnetohydrodynamics,
hydrodynamic stability, oceanic circulation, and dy-
namics of rotating fluids. Publications resulting from
this research are listed.

1484

Massachusetts Inst. of Tech. Dept. of Mathematics,
Cambridge.

A NOTE CONCERNING TOPOGRAPHY AND INERTIAL
CURRENTS, by H. P. Greenspan. [1963] [8]p. incl.
diagr. (AFOSR-64-0713) (AF 49(638)708) AD 436512
Unclassified

Also published in Jour. Marine Research, v. 21: 147-
154, Sept. 15, 1963.

A simple steady dynamical model of inertial currents
incorporating the effects of bottom topography is
studied. The results of this analysis and those of
preceding investigations indicate that topography may
exert considerable influence on the structure of the
Gulf Stream, on its separation point from the coastline,
and on its subsequent meander pattern. (Contractor's
abstract)

1485

Massachusetts Inst. of Tech. Dept. of Mathematics,
Cambridge.

ON A TIME-DEPENDENT MOTION OF A ROTATING

FLUID, by H. P. Greenspan and L. N. Howard. [1963]
[20]p. incl. diagrs. table. (AFOSR-64-0728) (AF 49-
(638)708) AD 437326; AD 439720   Unclassified

Also published in Jour. Fluid Mech., v. 17: 385-404,
1963.

The manner is considered in which the state of rigid
rotation of a contained viscous fluid is established. It
is found that the motion consists of 3 distinct phases,
namely, the development of the Ekman layer, the in-
viscid fluid spin-up, and the viscous decay of residual
oscillations. Boundary-layer theory is used to study
the phenomenon in the case of general axially symmetric
container configuration and explicit formulas are de-
duced which exhibit the effect of geometry in spin-up.
The special case of cylindrical side walls is also inves-
tigated by this method. The results of very simple ex-
periments confirm the theoretical predictions. (Con-
tractor's abstract, modified)

1486

Massachusetts Inst. of Tech. [Dept. of Mathematics]
Cambridge.

EXPLICIT FORMAL CONSTRUCTION OF NONLINEAR
QUANTUM FIELDS, by I. E. Segal. [1964] [14]p. incl.
refs. (AFOSR-64-2511) (AF AFOSR-63-342)
AD 454018   Unclassified

Also published in Jour. Math. Phys., v. 5: 269-282,
Feb. 1964.

It is shown that there can be associated with any given
nonlinear relativistic partial differential equation an
operator field satisfying the canonical commutation rela-
tions, transforming appropriately under the action of the
Lorentz group, and propagated in accordance with the
given differential equation. This quantization procedure
is unique, apart from the scale of the commutators.
The treatment is intuitive, but is capable of rigorization
in terms of the mathematical theory of analysis in func-
tion space (functional integration). (Contractor's
abstract, modified)

1487

Massachusetts Inst. of Tech. [Dept. of Mechanical
Engineering] Cambridge.

PERTURBATION TECHNIQUES FOR RANDOM VIBRA-
TION OF NONLINEAR SYSTEMS, by S. H. Crandall.
[1963] [6]p. (AFOSR-64-0118) (AF 49(638)564)
AD 430670; AD 434631   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 1700
1700-1705, Nov. 1963.

The random response of vibratory systems that are
only slightly nonlinear may be conveniently obtained by
applying the classical perturbation method. The present
paper describes and illustrates the procedure. Oscil-
lators with nonlinearity in the stiffness elements are
treated first because more-complete results can be ob-
tained when the damping remains linear. Then, systems

with more-general nonlinearities are examined. The techniques are illustrated by applications to simple one- and two-degree-of-freedom, nonlinear, vibratory systems.

1488

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

ZERO CROSSINGS, PEAKS AND OTHER STATISTICAL MEASURES OF RANDOM RESPONSES, by S. H. Crandall. [1963] [7]p. (AFOSR-64-0164) (AF 49(638)-564) AD 432558; AD 434632   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 1693-1699, Nov. 1963.

Several statistical properties of a stationary random process that are of interest in random vibration applications are reviewed. In the first three sections, the zero crossings, threshold crossings, distribution of peaks, and a simple model of fatigue damage are obtained directly from calculations. In the fourth and fifth sections, it is alternatively assumed that x(t) is the response of a particular nonlinear oscillator to random excitation. It is shown that certain statistical results can be obtained by utilizing the oscillator properties.

1489

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

LAMINAR BOUNDARY - LAYER WEDGE FLOWS WITH EVAPORATION AND COMBUSTION, by T.-N. Chen and T.-T. Toong. [1964] [22]p. incl. diagrs. refs. (AFOSR-64-0148) (AF 49(638)629)
          Unclassified

Presented at AIAA Heterogeneous Combustion Conf., Palm Beach, Fla., Dec. 11-13, 1963.

Also published in Prog. Astronaut. and Aeronaut., v. 15: 643-664, 1964.

A steady, laminar, boundary-layer flow of an oxidizer over a 2-dimensional wedge (covered with fuel) involving evaporation (or sublimation) and comubstion is studied for the case where chemical reaction is assumed to occur in an infinitesimally thin flame. Results presented include the effects of the Prandtl number, wedge parameter, and heat ratio on the profiles of the velocity, temperature, and composition in the boundary layer, the boundary-layer and displacement thickness, the flame position, the skin friction, and the rates of evaporation and combustion. Also included is a comparison of the boundary-layer characteristics with and without combustion. (Contractor's abstract, modified)

1490

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

THE SPECTRUM OF RANDOM VIBRATION OF A NONLINEAR OSCILLATOR, by S. H. Crandall. June 1964 [25]p. incl. refs. (AFOSR-64-1057) (AF 49(638)-1314) AD 604047   Unclassified

Presented at Eleventh Internat'l. Cong. of Applied Mechanics, Munich (Germany), Aug. 30-Sept. 5, 1964.

When a linear vibratory system is excited by a stationary random process, the most useful statistical description of the response is given by either the autocorrelation function or the spectral density. The exact calculation of these statistics for a nonlinear oscillator remains an unsolved problem although a general approach has been outlined. This paper describes three approximate procedures which apply to systems which are only slightly nonlinear. The procedures are perturbation, equivalent linearization, and a new heuristic method based on simply averaging the deterministic properties of the nonlinear system. It is shown that for vibratory systems with small stiffness nonlinearities all three procedures give autocorrelations (and spectra) which are identical to first order in the nonlinearity parameter. (Contractor's abstract)

1491

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

STAGNATION POINT HEATING IN IONIZED MON-ATOMIC GASES, by J. P. Reilly. June 1963 [26]p. incl. diagrs. refs. (Publication no. 641) (AFOSR-5442) (AF AFOSR-62-329) AD 430031   Unclassified

This paper reports on measurements made of the heat transfer to the stagnation point of a cylinder in partially ionized monatomic gases, and assesses the effect of free electrons on the total gas thermal conductivity. Comparison of the experimental data is made with 2 real-gas estimates, the first including the effects of ionization only on the thermodynamic properties involved, and a second including the effects of ionization on both the thermodynamic and transport properties. The experimental results are in substantial agreement with the latter prediction where equilibrium is attained, and confirms the prediction of an increased gas thermal conductivity due to the presence of free electrons. (Contractor's abstract, modified)

1492

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

NONLINEAR VIBRATIONS: A COMPARATIVE STUDY WITH APPLICATIONS TO CENTRIFUGAL PENDULUM VIBRATION ABSORBERS, by D. E. Newland. Doctoral thesis, May 1963, 1v. (AFOSR-5224) (AF AFOSR-63-154) AD 415914   Unclassified

This thesis is in 2 parts. Part 1 is a comparative study of methods for the analysts of nonltnear vibrations. It ts prtmarily concerned with forced vibrations, and ts restrtcted to lumped parameter systems (systems with a ftntte number of degrees-of-freedom). Part 2 ts the appltcation of the most suitable of these methods to problems occurrtng tn the destgn of centrifugal pendulum vibration absorbers.

1493

Massachusetts Inst. of Tech. [Dept. of Mechanical Engtneertng] Cambrtdge.

[THE JUMP PHENOMENON OF THE ABSORBED VIBRATIONS OF A NONLINEAR CENTRIFUGAL PENDULUM WITH LARGE ANGLES OF DISPLACE-MENT] Il fenomeno del salto non ltneare nel funzionamento degli assorbitori di vibrazioni a pendolo centrifugo ad angoli grandi, by J. P. Dan Hartog. [1964] [11]p. tncl. illus. diagrs. (AFOSR-65-0328) (AF AFOSR-63-154) AD 611956   Unclassified

Also publtshed tn Scuola tn Azione, No. 14: 30-40, 1963-1964.

The torsion vibrations in the alternating combustion engine are studied with the purpose of clarifying the regulatory action and behavior of a nonlinear centrifugal-pendulum-vibration absorber. The oscillation angle of the pendulum exceeded 80° as a result of the non-linear oscillation. The bastc governtng equations are reduced to a nonltnear equation.

1494

Massachusetts Inst. of Tech. [Dept. of Mecnanical Engtneertng] Cambrtdge.

APPROXIMATE ANALYTICAL SOLUTION OF SIMILARITY BOUNDARY LAYER EQUATIONS WITH VARIABLE FLUID PROPERTIES, by N. H. Kemp. Sept. 1964, 72p. (Fluid Mechanics Lab. publ. no. 64-6) (AFOSR-64-1934) (AF AFOSR-63-353) AD 606870   Unclassifted

An approximate method of the integral type ts developed for computing heat transfer and shear stress tn stmi-lartty boundary-layer problems of single flutds with variable fluid properties. It ts applied to flat-plate, stagnation-point, and shock-tube end-wall geometrtes. Simple analytical formulas are developed tnvolvtng tntegrals over the fluid properties. It ts shown that a simple relation exists between the heat transfer tn the stagnation-potnt and end-wall cases, enabltng bounds on the stagnation-potnt heat transfer rate to be found from calculations for the stmple end-wall geometry.

1495

Massachusetts Inst. of Tech. Dept. of Mechantcal Engtneertng, Cambridge.

ENTRY HEAT TRANSFER AT SUPER-ORBITAL

SPEEDS, by J. A. Fay. Aug. 1964 [31]p. tncl. diagrs. refs. (Fluid Mechantcs Lab. publ. no. 64-7) (AFOSR-64-1935) (AF AFOSR-63-353) AD 606869
Unclassified

In thts paper estimates are given of the expected rela-tive magnttudes of modes of heat transfer at the stagna-tion point of a blunt body for fltght velocities above 20 km/sec and for altitudes at whtch continuum flow exists, so that the prtnctpal mode of heat transfer may be determtned. With respect to the convective heat transfer, the detatled theories appltcable tn the veloctty range of 10 to 20 km/sec are reviewed and the state of knowledge of the transport properties ts discussed. Radiation heating due to continuum and ltne radiation ts estimated from existing calculations tn order to deter-mtne the fltght conditions for whtch the shock layer becomes opaque and body stze for whtch radiation ex-ceeds the conrecttve heating. The problem of shock wave formation and tontzation relaxation ts also dis-cussed. (Contractor's abstract, modified)

1496

Massachusetts Inst. of Tech. [Dept. of Phystcs] Cambrtdge.

THE CONCEPTUAL STRUCTURE OF PHYSICS, by L. Tisza. [1963] [35]p. (Technical rept. no. 409) (AFOSR-2577) (AF 49(638)95) AD 401297; AD 408476
Unclassified

Also publtshed tn Rev. Modern Phys., v. 35: 151-185, Jan. 1963.

This paper describes a new technique of logical analysts that is to brtng about a more harmontous relation be-tween conceptual thinking and formal developments. However, this ts to be achieved wtthtn a program the scope of whtch ts much more modest and manageable than the one htnted at by Einstein. It ts proposed to sort out and tmprove the logical structure of the existtng empirtcally verified theortes. The establtshment of a new foundation ts the expected outcome rather than the prerequisite of this procedure.

1497

Massachusetts Inst. of Tech. Dept. of Physics, Cambrtdge.

THE STATISTICAL THERMODYNAMICS OF EQUI-LIBRIUM, by L. Tisza and P. M. Quay. Oct. 15, 1963 [43]p. incl. refs. (Techntcal rept. no. 414) (AFOSR-64-0268) (AF 49(638)95) AD 428952; AD 431084
Unclassifted

Also published tn Ann. Phys., v. 25: 48-90, Oct. 1963.

A stattstical thermodynamtcs ts developed tn terms of extensive vartables (additive invartants) distrtbuted over a cellular division in space. In general, thts distribution is govered by randomness and correlations. The present theory, however, deals expltctty only with randomness, although correlations are tmpltctt tn the

so-called fixed variables of the system. Because of this restriction, the theory is valid only for the fluctuations of coupled systems that have reached their equilibrium. A set of postulates is advanced, the essence of which is the requirement that distribution functions (d.f.) exist for two basic coupling situations. (Contractor's abstract, modified)

1498

Massachusetts Inst. of Tech. [Electronics Systems Lab.] Cambridge.

[A SAMPLE DATA MODEL FOR EYE TRACKING MOTION] Ein Abtastmodell fur augenfolgebewegungen, by L. R. Young and L. Stark. [1963] [4]p. (AFOSR-64-0541) (AF 49(638)1130) AD 436164 Unclassified

Also published in Regelungstechnik, v. 4: 148-151, Jan. 1, 1963.

The biological control system which directs our eyes to an object of interest, and enables them to follow a moving target, was investigated from a servomechanisms point of view. Envidence from deterministic transient movements and the frequency response led to a sampled data model for the system, with a sampling period corresponding to the psychological refractory period of 0.2 second. In addition to describing normal tracking, the model predicts the observed changes in transient and frequency characteristics and the limits of stability as the effective visual feedback is varied.

1499

Massachusetts Inst. of Tech. Electronics Systems Lab., Cambridge.

VARIABLE FEEDBACK EXPERIMENTS TESTING A SAMPLED DATA MODEL FOR EYE TRACKING MOVEMENTS, by L. R. Young and L. Stark. [1963] [14]p. (AFOSR-64-0549) (AF 49(638)1130) AD 436156 Unclassified

Also published in IEEE Trans. Human Factors Electron., v. HFE-4: 38-51, Sept. 1963.

A sampled data model is presented to describe the action of the control system for directing human gaze at a moving target. The plausibility of the model is supported by its successful prediction of experimental tracking characteristics under variable effective visual feedback. The feedback is altered by addition of an external signal from measured eye position to target position, and its effects on the frequency and transient responses of the model and the experimental records are compared.

1500

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

MAGNETOHYDRODYNAMIC SHOCK WAVES, by

J. E. Anderson. 1963, 226p. (AFOSR-5317) (AF AFOSR-62-84) AD 425591   Unclassified

A study was made of the existence, uniqueness, and qualitative properties of steady-state magnetohydrodynamic shock waves and their stability with respect to breakup as a result of small-flow disturbances. As some knowledge of magnetohydrodynamic shock waves is assumed in the reader, the conservation (Rankine-Hugoniot) relations for these shock waves are discussed only in enough detail to provide background needed for the primary topic.

1501

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

[COHERENT LIGHT AND RADIO OPTICS] Final rept. Feb. 1962-June 1963, 7p. incl. refs. (AFOSR-J1342) (AF AFOSR-62-317) AD 428961   Unclassified

The research performed under this contract has dealt with the fluorescence and absorption of rare earth ionic and transition metal ionic solids of importance in optical masers and analyses of temporal, spatial and spectral properties in coherent emission from solids. Attempts have been made to use coherent light in new experiments in physics. These include the observations of nonlinear response in massive dielectrics, and on photo emissive surfaces with the object of detecting beat frequencies in the submillimeter spectral range.

1502

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

TEMPERATURE AND RISE-TIME DEPENDENCE OF THE ELECTRIC STRENGTH OF ALKALI HALIDE CRYSTALS, by F. W. Kaseta. Mar. 1963, 39p. incl. diagrs. tables, refs. (Technical rept. no. 177) (AFOSR-4689) (Nonr-184110) AD 403657
          Unclassified

Techniques were developed to extend d-c and impulse breakdown measurements to liquid-helium temperature. The breakdown strength of KCl was measured from 4.2° to 425°K with d-c voltages and 1- and 10-μsec rise-time pulses. The breakdown strength was lower for d-c voltages than for pulses over the entire temperature range. Changing the pulse rise time from 1 to 10 μsec had little effect on electric strength. No thickness dependence was observed. The electric strength of a mixed crystal (75% KCl - 25% RbCl) was measured from 77° to 375°K. (Contractor's abstract, modified)

1503

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

PIEZOELECTRIC COUPLING BETWEEN ULTRASONIC WAVES AND FREE ELECTRONS IN CADMIUM

SULFIDE, by K. W. Nill. July 1963, 20p. incl. illus. diagrs. refs. (Technical rept. no. 181) (AFOSR-64-0629) (Nonr-184110) AD 414853   Unclassified

In some semiconductors, there is strong coupling between lattice waves and free electrons due to the piezoelectric effect. This coupling provides an energy-exchange mechanism from the electron system to the lattice system. This transfer is experimentally observed here as the amplification of an ultrasonic wave and as an acoustoelectric current resulting from the wave-electron drag. Experimental results are presented which support an acoustoelectric-effect explanation of a kink in the current-voltage characteristics of piezoelectric semiconductors. (Contractor's abstract)

1504

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

FREQUENCY AND TEMPERATURE RESPONSE OF THE POLARIZATION OF BARIUM TITANATE, by J. M. Ballantyne. Mar. 1964, 34p. incl. illus. diagrs. tables, refs. (Technical rept. no. 188) (AFOSR-64-0908) (Nonr-184110)   Unclassified

The frequency and temperature response of the polarization of $BaTiO_3$ from 0 to 1000 cm^{-1} and between 24° and 200°C has been determined by transmission and reflectivity measurements. The infrared transmission of thin single-crystal $BaTiO_3$ has been recorded from 250 to 4000 cm^{-1}. The reflectivity of single-domain $BaTiO_3$ has been measured continuously from 10 to 4000 cm^{-1}, and at points of 0, 77, 5, and 10 cm^{-1}. Reflectivity analysis indicates that the dispersion of the polarization in single-domain $BaTiO_3$ from 1 to 1000 cm^{-1} consists of 3 resonances, at 12, 182, and 491 cm^{-1}. The 12-cm^{-1} resonance is responsible for the ferroelectric state and exhibits an unusual dispersion characteristic, being broad and possessing an extended high-frequency tail. The integrated intensity of the 12-cm^{-1} resonance is very large and above the Curie point decreases rapidly with increasing temperature. (Contractor's abstract, modified)

1505

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

FLUORESCENCE OF TRANSITION METAL IONS IN CRYSTALS, by B. Di Bartolo. June 1964, 67p. incl. illus. diagrs. tables, refs. (Technical rept. no. 190) (AFOSR-64-1368) (Nonr-184110) AD 603459
Unclassified

Experiments were made to evaluate the temperature dependence of linewidth, lineshift, and lifetime of the peaked fluorescence presented by Cr^{3+} and V^{2+} impurities in Al_2O_3 and MgO. The vibronic spectrum associated with the $^2E - {}^4A_2$ fluorescence transition at 8700A of V^{2+} in MgO has been investigated as a function of temperature. The fluorescence lifetime of the ^2E level, which is 50 msec and nearly temperature-

independent at 77°K, decreases rapidly above 200°K to ~ 0.03 msec at 300°K. (Contractor's abstract, modified)

1506

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

BREAKDOWN STRENGTH OF ALKALI HALIDES AS FUNCTION OF TEMPERATURE AND DISLOCATION DENSITY, by R. Nevald. Oct. 1964, 22p. (Technical rept. no. 193) (Nonr-184110) AD 608827
Unclassified

The d-c breakdown strength of NaCl, RbBr, and KI single crystals was measured from 4.2° to 400°K. The characteristics consist of a slow rise at low temperatures followed by a steep decrease in the high-temperature region. The electric strength of NaCl crystals was measured as function of temperature for four different dislocation densities. For high dislocation densities, the rising section of the characteristic flattens, the falling section steepends, and the maximum shifts to lower temperatures. These trends conform with previous findings on the effect of addition agents and the transition from crystal to glass.

1507

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

ELECTRONIC BAND STRUCTURE OF TiC, TiN, AND TiO, by V. Ern and A. C. Switendick. Oct. 1964, 28p. (Technical rept. no. 192) (Nonr-184110) AD 608826
Unclassified

The band structure of metallic face-centered cubic TiC, TiN, and TiO has been obtained by the augmented plane wave (APW) method at the equivalent of 256 points in the Brillouin zone and for an energy range appropriate to cover the nonmetal 2s and 2p and the titanium 3d and 4s states. A density of states, the Fermi energy, and contours of constant energy were obtained for the 3 compounds. A charge distribution in the APW scheme was derived from the equivalent of 32 points in the zone, and the admixture of the bands was analyzed. The results are consistent with the available experimental data.

1508

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

EXTENSIVE AIR SHOWERS AT 5200 METRES ABOVE SEA LEVEL AND SEARCH FOR HIGH ENERGY PRIMARY GAMMA RAYS, by G. Clark, I. Escobar and others. 1964, 60p. (AFOSR-64-1757) (AF 49(638)922) AD 442210   Unclassified

Also published in Pontificiae Academia Scientiarum Scripta Varia, v. 25: 29-60, 1963.

Part I of the report describes the chief characteristics

of EAS observed at 5200 m above sea level. The main results of this study are: (1) the observed showers having sizes in the range approximately 105 to 106 are near their maximum development; (2) the fluctuations in the number of muons in the observed showers is only one third of that observed at sea level; and (3) the lateral distribution of the observed showers, follows N.K.G. function with best 's' value slightly less than unity. Part II of the report mainly outlines the approach for the search for high energy primary gamma rays.

1509

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE GENERATION OF HIGH MAGNETIC FIELDS, by D. B. Montgomery. [1963] [36]p. incl. diagrs. tables, refs. (AFOSR-J1116) (AF 19(604)7344) AD 420517
Unclassified

Also published in Rept. Prog. Phys., v. 26: 69-104, 1963.

The generation of high magnetic fields by means of water-cooled magnets, iron magnets, pulsed magnets, cryogenic magnets and superconducting magnets is discussed. Relationships between currents, fields, power, magnetic stresses, cooling requirements and field homogeneity are presented in detail. Fabrication techniques, power supplies and specific magnet constructions are discussed. Reference is made to nearly 100 papers giving more detail on specific subjects. (Contractor's abstract)

1510

[Massachusetts Inst. of Tech. National Magnet Lab., Cambridge]

ELECTRONIC POLARIZABILITIES AND STERNHEIMER SHIELDING FACTORS, by R. E. Watson and A. J. Freeman. [1963] [6]p. (AFOSR-J1118) (AF 19(604)-7344) AD 421050
Unclassified

Also published in Phys. Rev., v. 131: 250-255, July 1, 1963.

A new method is developed for determining the distortions (polarizabilities) induced in electronic distributions by valence electrons and/or crystalline fields and their effect (expressed as Sternheimer shielding factors) on magnetic and electric hyperfine interactions. It is shown that the 'angular' excitations are gotten by relaxing the usual restriction that the spatial part of the one-electrons of the same shell but differing in magnetic quantum number have the same radial function yields the 'radial' excitations. Calculations are reported for several spherical ions (Cl and Cu) in an external field, but the scheme is also applicable to the problem of induced electric quadrupole (and magnetic dipole and higher multipole) distortions of an ion by its own aspherical charge distribution.

1511

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE NATIONAL MAGNET LABORATORY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, by F. Bitter. [1963] [7]p. (AFOSR-J1595) (AF 19(604)-7344) AD 427635
Unclassified

Also published in Birt. Jour. Appl. Phys., v. 14: 759-765, Nov. 1963.

This paper reviews magnetic fields available in pulsed coils and continuous operation, using normal conductors. The new laboratory in operation at the Massachusetts Institute of Technology is described. This involves primarily four generators designed to produce 10,000A continuously, and current pulses up to 40,000A each for times diminishing to a few seconds, and at voltages of 200-250 v. The power and corresponding cooling water can be made available at 10 locations by remote control. The generators may be operated independently and simultaneously or in any series or parallel combination desired.

1512

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

HIGH-PRESSURE TRANSITIONS IN A(III)B(VI) COMPOUNDS: INDIUM TELLURIDE, by M. D. Banus, R. E. Hanneman and others. [1963] [2]p. (AFOSR-J159.) (AF 19(604)7344) AD 427628
Unclassified

Also published in Science, v. 142: 662-663, Nov. 8, 1963.

Metallic InTe(II) has a NaCl structure with AO = 6.154A and becomes superconducting below 3.5°K. These results are substantially different from those previously reported. The pressure temperature diagram to 850°C and 50 kb is presented.

1513

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ANTISHIELDING OF MAGNETIC AND ELECTRIC HYPERFINE INTERACTIONS IN OPEN SHELL IONS, by A. J. Freeman and R. E. Watson. [1963] [8]p. (AFOSR-64-0428) (AF 19(604)7344) AD 434317
Unclassified

Also published in Phys. Rev., v. 131: 2566-2573, Sept. 15, 1963.

Previously a method was presented for determining the contribution of closed atomic shells to magnetic and electric hyperfine interactions. This method is discussed and applied to the study of the antishielding of both magnetic dipole and electric quadrupole interactions associated with the aspherical valence electrons of atoms and ions. In addition to closed shell

antishielding, it is shown that there are repercussions within the open shell which are significant for hyperfine interactions. Results of specific computations for the free Fe^{2+} ion and the Cl atom are given, and comparisons are made with earlier perturbation theory results.

1514

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SEARCH FOR FERROMAGNETICALLY TRAPPED MAGNETIC MONOPOLES OF COSMIC-RAY ORIGIN, by E. Goto and H. Henry. [1963] [10]p. (AFOSR-64-0468) (AF 19(604)7344) AD 435657   Unclassified

Also published in Phys. Rev., v. 132: 387-396, Oct. 1, 1963.

Magnetic monopoles, if they exist, should be trapped and accumulated in ferromagnetic outcrop on the earth's surface and from fragments of a stony-iron meteorite. In the nuclear emulsions used for detection, no tracks were found satisfying our geometric criteria and having an energy-loss rate compatible with the theoretical expectation for monopoles. The area-time product of the magnetite cosmic-ray exposure is estimated to be about 10^{13} cm^2 sec. From the negative results, upper-limit monopole production cross sections in the atmosphere are estimated as a function of assumed monopole mass.

1515

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

MAGNETIC-FIELD DEPENDENCE OF FREE-CARRIER ABSORPTION IN SEMICONDUCTORS, by J. K. Furdyna and M. E. Brodwin. [1963] [8]p. incl. diagrs. table, refs. (AFOSR-64-0469) (AF 19(604)-7344) AD 435655   Unclassified

Also published in Phys. Rev., v. 132: 97-104, Oct. 1, 1963.

A plane-wave semiclassical analysis of the amplitude of an electromagnetic wave transmitted through a semiconductor in the presence of a magnetic field is discussed and some theoretical predictions are compared with experimental measurements. The Faraday and the Voigt configurations, longitudinal and transverse, respectively, are specifically considered. The theoretical results, obtained formally in terms of the high frequency conductivity tensor, are applied to the isotropic, one-carrier semiconductor model. The general expression, covering all ranges of frequency and magnetic field within the extent of validity of the model, is derived and reduced to simple forms applicable to specific experimental situations. (Contractor's abstract, modified)

1516

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SHIELDING AND DISTORTION OF RARE-EARTH CRYSTAL FIELD SPECTRA, by R. W. Watson and A. J. Freeman. [1964] [14]p. (AFOSR-64-1253) (AF 19(604)7344) AD 442815   Unclassified

Also published in Phys. Rev., v. 133: A1571-A1584, Mar. 16, 1964.

The contributions of the closed atomic shells to electrostatic interaction are examined and are found to be significant in several respects: (1) the magnitude of the crystal-field splittings are reduced from the values obtained by considering just the 4F shell alone; and (2) the result that the ordering and relative spacing of the crystal-field levels are not necessarily those implied by the 4F crystal-field matrix elements alone. It is shown that in some cases the distortion of the ion's charge distribution produces severe deviations from the crystal-field level scheme predicted by VC directly. Also investigated is the role played by the crystal field in producing by means of the distortion of the closed and 4F shells, and the interaction of these distortions with the open 4F shell, contributions to the magnetic (and electric) hyperfine interactions.

1517

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SUPERCONDUCTING MAGNETS, by D. B. Montgomery. [1964] [11]p. incl. illus. diagrs. table, refs. (AFOSR-64-1738) (AF 19(604)7344) AD 448284   Unclassified

Also published in IEEE Spectrum, v. 1: 103-113, Feb. 1964.

The contents of this report are: Wire characteristics; Degradation effect; Solenoid design; Coil protection; Mechanical stresses; Dewar vessels; and Power supplies.

1518

Massachusetts Inst. of Tech. [National Magnet Lab.] Cambridge.

MAGNETIC TRANSLATION GROUP. II. IRREDUCIBLE REPRESENTATIONS, by J. Zak. [1964] [5]p. (AFOSR-64-1739) (AF 19(604)7344) AD 448282   Unclassified

Also published in Phys. Rev., v. 134: A1607-A1611, June 15, 1964.

The physical irreducible representations of the magnetic translation group (M. T. G.) defined previously have been found. From these a set of solutions of Schrodinger's equation for a Bloch electron in a magnetic field has been constructed. In general the M. T. G. is non-Abelian. However, when the magnetic flux through

areas enclosed by any vectors of the Bravais lattice become multiples of an elementary 'fluxon' hc/e, the M. T. G. becomes isomorphic to the usual translation group.

1519

Massachusetts Inst. of Tech. [National Magnetic Lab.] Cambridge.

MAGNETIC TRANSLATION GROUP, by J. Zak. [1964] [5]p. (AFOSR-64-1740) (AF 19(604)7344) AD 448287
Unclassified

Also published in Phys. Rev., v. 134: A1602-A1606, June 15, 1964.

A group-theoretical approach to the problem of a Bloch electron in a magnetic field is given. A magnetic translation group is defined and its properties, in particular its connection with the usual translation group, are established.

1520

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

COVALENCY IN CRYSTAL FIELD THEORY: $KNiF_3$, by R. E. Watson and A. J. Freeman. [1964] [21]p. (AFOSR-64-2076) (AF 19(604)7344) AD 451356
Unclassified

Also published in Phys. Rev., v. 134: A1526-A1546, June 15, 1964.

The theory of covalency in crystal field phenomena is examined, using, as example, the Ni-F6 complex in $KNiF_3$. The Hund-Mulliken-Van Vleck molecular orbital-linear combination of atomic orbitals treatment is followed. The role of the antibonding and bonding electrons in the complex is discussed from a multi-electron point of view. The exact self-consistent one-electron Hamiltonian is discussed in some detail. Emphasis is placed on elucidating the source and nature of the covalent effects appropriate to the various physical phenomena. It was found that it is the covalent mixing of those bonding electrons having no antibonding partners which contribute to all experimental observables.

1521

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

BULK ABSORPTION OF RADIATION IN SUPERCONDUCTORS, by E. E. H. Shin. [1964] [7]p. (AFOSR-64-2089) (AF 19(604)7344) AD 451349
Unclassified

Also published in Phys. Rev., v. 135: A299-A305, July 20, 1964.

Perturbation theory is applied to calculate the spectral

shape of the bulk absorption of radiation in a superconductor. The second-order processes involving one photon and one phonon are considered. The resulting spectrum exhibits a spike near the frequency corresponding to the energy gap. This is attributed to the large values of the BCS density of states at the gap edges.

1522

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

CALCULATION OF MAGNETIC HYPERFINE CONSTANT OF P^{31}, by N. Bessis, H. Lefebvre-Brion and others. [1964] [3]p. (AFOSR-64-2090) (AF 19(604)7344) AD 451721
Unclassified

Also published in Phys. Rev., v. 135: A588-A590, Aug. 3, 1964.

The results of different kinds of calculations, which use the concept of spin polarization, all predict a negative sing of the magnetic hyperfine constant of the 4s ground state of P^{31} in contradiction with the sign deduced by Lambert and Pipkin from an optical pumping experiment. This result means that either an error in experimental sign has been made or that the first serious breakdown of the exchange polarization model has been found.

1523

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SATURATION MAGNETORESISTANCE AND IMPURITY SCATTERING ANISOTROPY IN n-TYPE SILICON, by L. J. Neuringer and D. Long. [1964] [6]p. (AFOSR-64-2093) (AF 19(604)7344) AD 451353 Unclassified

Also published in Phys. Rev., v. 135: A788-A793, Aug. 3, 1964.

In the classical strong-field region the magnetoresistance of semiconductors is expected to saturate. If one investigates the dependence of the saturation magnetoresistance upon the strength of ionized-impurity scattering, quantitative conclusions may be drawn concerning the anisotropy of the relaxation time for such scattering. The strong-field longitudinal magnetoresistance and carrier mobility of phosphorus-doped silicon have been studied in dc magnetic fields to 90 kg at 78°K.

1524

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ELECTRON SPIN RESONANCE STUDIES WITH SUPERCONDUCTING MAGNETS: THE SPECTRUM OF Dy^{3+} AND Sm^{3+} IN CaF_2, by W. Low. [1964] [4]p. (AFOSR-64-2345) (AF 19(604)7344) AD 451932
Unclassified

Also published in Phys. Rev., v. 134: A1479-A1482, June 15, 1964.

An electron spin resonance spectrometer has been constructed using strong magnetic fields up to 46,000 G generated by a superconducting magnet. It is being used for the measurement of the magnetic properties of transition elements in ionic crystals such as (1) small g factors, (2) energy level sparations up to 1/20 cm, (3) isotropic and anisotropic exchange terms in spectra pairs of paramagnetic ions, (4) spin-lattice relaxation times at high magnetic fields.

1525

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

QUADRUPOLE ANTISHIELDING FACTORS FOR RARE-EARTH AND SOME OTHER HEAVY IONS, by R. E. Watson and A. J. Freeman. [1964] [4]p. (AFOSR-64-2449) (AF 19(604)7344) AD 453807   Unclassified

Also published in Phys. Rev., v. 135: A1209-A1212, Aug. 31, 1964.

Sternheimer quadrupole antishielding factors are reported for several rare-earth ions and for several ions isoelectronic with I⁻ and Br⁻. Radial excitations were obtained using the self-consistent-field unrestricted Hartree-Fock method described previously. Comparisons with perturbation-theory estimates of Sternheimer are presented.

1526

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE OPERATION OF OPTICAL MASERS IN UNIFORM MAGNETIC FIELDS, by W. A. Runciman. [1964] [4]p. (AFOSR-64-2521) (AF 19(604)7344) AD 453808   Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), v. 1: 673-676, 1964.

Optical masers usually emit light of a single frequency with a narrow line width. If an optical maser is operated in a homogeneous magnetic field, we might find the following advantages. The emission frequency might be tuned by an amount up to the half-width of the Zeeman pattern normally associated with the transition. It is also possible that two or more frequencies be simultaneously emitted allowing the formation of variable sum and difference frequencies when the light is incident on a non-linear dielectric. Finally, it may be possible to reduce the operating threshold. Preliminary results are now reported on a solid state and a gaseous optical maser to test these ideas.

1527

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SPIN EFFECTS ON THE LONG-WAVELENGTH OSCIL-LATIONS OF A QUANTUM PLASMA IN A MAGNETIC FIELD, by N. J. Horing. [1964] [6]p. (AFOSR-65-0165) (AF 19(604)7344) AD 611519   Unclassified

Also published in Phys. Rev., v. 136: A494-A499, Oct. 19, 1964.

The results of earlier work on the quantum theory of electron-gas plasma oscillations in a magnetic field are extended to take account of the difference in masses associated with the orbital and spin parts of the individual electronic motions in the presence of a lattice, and allowance is made for an anomalous electronic g factor. Tractable expressions for the complete plasmon dispersion relation and damping constant (at arbitrary temperature and arbitrary magnetic field strength), which are obtained using a Green's function formulation of the random-phase approximation, are reported. The low-wave-number (p) approximation of the dispersion relation is investigated in detail.

1528

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

GROUP-THEORETICAL CONSIDERATION OF LANDAU LEVEL BROADENING IN CRYSTALS, by J. Zak. [1964] [5]p. (AFOSR-65-0166) (AF 19(604)7344) AD 611518   Unclassified

Also published in Phys. Rev., v. 136: A776-A780, Nov. 2, 1964.

A group-theoretical classification of the energy levels for a Bloch electron in a magnetic field is given. The fact is used that the magnetic translation group is a subgroup of the symmetry group for a free electron in a magnetic field, and it is shown that the broadening of the Landau levels in crystals is a general feature that follows from symmetry considerations. An explicit formula for the broadening in the case of cubic symmetry is derived.

1529

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SIGN OF THE MAGNETIC HYPERFINE FIELD IN DILUTE IRON ALLOYS USING THE MOSSBAUER EFFECT, by N. Blum and L. Grodzins. [1964] [5]p. (AFOSR-65-0167) (AF 19(604)7344) AD 611520   Unclassified

Also published in Phys. Rev., v. 136: A133-A137, Oct. 5, 1964.

The sign of the hyperfine field in several dilute iron alloys has been determined. The technique makes use

of the Mossbauer effect, which is used to establish the helicity of gamma rays emitted and absorbed in a longitudinal magnetic field. Experiments were performed which show that the field induced at the iron nucleus by the application of an external magnetic field H_O is negative, i.e., opposite to H_O in Mossbauer sources of Co^{57} in Cu and Au and in absorbers of Mo and Rh containing about 1% Fe^{57}. The spontaneous field H_{int} observed in a 1/2% Fe^{57}-in-Cu alloy below 50°K is positive.

1530

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ONE-DIMENSIONAL EQUATION FOR A TWO-DIMEN-SIONAL BLOCH ELECTRON IN A MAGNETIC FIELD, by J. Zak. [1964] [3]p. (AFOSR-65-0731) (AF 19-(604)7344) AD 614862   Unclassified

Also published in Phys. Rev., v. 136: A1647-A1649, Dec. 14, 1964.

Because of its relation to quantum effects in solids, it is of interest to study the behavior of a Bloch electron in the plane perpendicular to an external magnetic field. The dynamics of an electron in a two-dimensional periodic potential and a constant magnetic field perpendicular to the plane of motion is discussed. Using symmetry-adapted functions an exact one-dimensional Schroeinger equation for this two-dimensional Bloch electron in a magnetic field has been derived. By contrast to other methods, since no approximations were introduced in the derivation, this one-dimensional equation contains all the information for describing the dynamics of the problem.

1531

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ULTRASONIC AND THERMAL BEHAVIOR OF Nb-25% Zr IN STRONG MAGNETIC FIELDS, by L. J. Neuringer and Y. Shapira. [1964] [3]p. incl. diagrs. table. (AFOSR-65-0732) (AF 19(604)7344) AD 614851   Unclassified

Also published in Solid State Commun., v. 2: 349-351, 1964.

In this note it is reported that (1) a distinct attenuation edge, as a function of magnetic field intensity, exists for ultrasonic shear waves propagated along the direction of the field in a Nb-25% Zr alloy below its transition temperature, T_c; (2) this edge can be traversed in a reversible manner as a function of the applied magnetic field and is absent at 77°K; (3) the magnetic field at which the attenuation edge occurs at 4.2°K agrees to within 2 kgauss with H_{c2}, the upper critical field, as determined by magnetization measurements on the same sample, and is also in agreement with the transition field obtained from resistance measurements on samples of similar composition; (4) heating spikes and

ultrasonic attenuation bursts (in one to one correspondence) have been observed as a function of magnetic field for $H < H_{c2}$ at 2° and 4.2°K.

1532

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

UMKLAPP CONTRIBUTION TO BULK ABSORPTION IN SUPERCONDUCTORS, by E. E. H. Shin. [1964] [4]p. incl. diagr. refs. (AFOSR-65-0735) (AF 19-(604)7344) AD 616044   Unclassified

Also published in Phys. Rev., v. 136: A889-A892, Nov. 16, 1964.

The second-order umklapp contribution to the bulk absorption of radiation is calculated for superconductors at very low temperatures and is compared with the previously calculated normal phonon contributions. The umklapp absorption spectrum exhibits a sharp peak at the frequency ω_g representing the superconducting energy gap. For Pb, it is not only larger than the normal phonon absorption by many orders of magnitude but is also comparable with the skin absorption. It can also exhibit anisotropy in a single crystal through the polarization factor $(\hat{e} \cdot g)^2$ (where $\hat{e}$ is a unit vector in the direction of polarization of the incident radiation and g = reciprocal lattice vector), which appears in the expression for the umklapp absorption rate. (Contractor's abstract)

1533

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

INFLUENCE OF LANDAU LEVEL BROADENING ON THE DE HAAS-VAN ALPHEN EFFECT, by S. J. Williamson, S. Foner, and R. A. Smith. [1964] [3]p. (AFOSR-65-0736) (AF 19(604)7344)   Unclassified

Also published in Phys. Rev., v. 136: A1065-A1067, Nov. 16, 1964.

Dingle's treatment of the influence of Landau level broadening on the de Haas-van Alphen effect is extended by the method of Lifshitz and Kosevich to include a Fermi surface of arbitrary shape. It is shown that a momentum-dependent or energy-dependent linewidth can influence the period, phase, and amplitude of the magnetization oscillations, although crude estimates indicate that in many cases the effects would be quite small. (Contractor's abstract)

1534

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ANTIFERROMAGNETIC RESONANCE IN SYSTEMS WITH DZYALOSHINSKY-MORIYA COUPLING; ORIENTA-TION DEPENDENCE IN αFe_2O_3, by S. J. Williamson

and S. Foner. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-0737) (AF 19(604)7344) AD 616173 Unclassified

Also published in Phys. Rev., v. 136: A1102-A1106, Nov. 16, 1964.

Resonance conditions for an antiferromagnet whose sublattice magnetization vectors are canted by the Dzyaloshinsky-Moriya interaction are generalized to include an arbitrary angle θ between the applied magnetic field and the hard direction of magnetization, and the resulting normal modes are discussed. A correction term to the low-frequency resonance expressions derived by Pincus may be appreciable at higher magnetic fields and small θ. For suitable parameters, this term permits the measurement of all pertinent effective fields by resonance experiments. It is furthermore shown that demagnetization effects are negligible. Microwave resonance experiments as a function of field to 60 kgauss angle and frequency 12 to 35 gauss cps on synthetic single crystals of α Fe$_2$O$_3$ failed to reveal a departure from the Pincus relation, thus leading to the conclusion that $H_A/H_E < 10^{-2}$. (Contractor's abstract)

1535

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

MAGNETS FOR FIELDS ABOVE 100 KILOGAUSS, by D. B. Montgomery. [1964] [2]p. incl. diagrs. (AFOSR-65-1173) (AF 19(604)7344) AD 621654 Unclassified

Presented at Northeast Electronics Research and Engineering Meeting, Boston, Mass., Nov. 4-6, 1964.

Also published inNEREM Record, 1964.

Methods of generating high magnetic fields beyond those obtainable with laboratory-type iron magnets are discussed. The only practical methods other than high-field superconductors, use copper magnets, water-cooled for continuous duty, and uncooled or pre-cooled for pulse duty. For water-cooled magnets, the cooling process and the strong forces of the high water velocities c nstitute the principal design problems.

1536

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

INTENSE MAGNETIC FIELDS FOR RESEARCH, by A. J. Freeman. [1964] [2]p. (AFOSR-65-1174) (AF 19(604)7344) AD 621302 Unclassified

Presented at Northeast Electronics Research and Engineering Meeting, Boston, Mass., Nov. 4-6, 1964.

Also published in NEREM Record, 1964.

A review is presented of the developments in and importance of intense magnetic field research. Intense magnetic fields are considered to be those above 30,000 gauss and are produced by air core magnets up

to 160,000 gauss on a continuous basis. In basic research, magnetic fields are valuable in revealing the structure of specific materials and the general physical laws governing all matter. Intense magnetic fields reveal a considerable amount of data that could not be obtained at all or that would be much less effective with weaker fields.

1537

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE DETERMINATION OF FORCED-CONVECTION SURFACE-BOILING HEAT TRANSFER, by A. E. Bergles and W. M. Rohsenow. [1963] [8]p. incl. diagrs. refs. (AFOSR-65-1439) (AF 19(604)7344) AD 627484 Unclassified

Presented at ASME-AIChE Heat Transfer Conf. and Exhibit, Boston, Mass., Aug. 11-14, 1963. (Paper No. 63-HT-22)

The characteristics of the boiling curve for forced convection surface boiling are examined in detail. In the region of low wall superheat, the heat transfer can be predicted by available correlations for forced convection. An analysis is presented for the inception of first significant boiling. Experimental results are in good agreement with analytical predictions. Pool-boiling data were taken under saturated and subcooled conditions for surfaces similar to those used in forced-convection surface boiling. These data indicate that the curves for forced-convection surface boiling cannot be based on data for saturated pool boiling but must rather be based on actual forced-convection data. (Contractor's abstract)

1538

Massachusetts Inst. of Tech. National Magnet Lab., Cambrdige.

STRONG-FIELD GALVANOMAGNETIC EFFECTS IN n-TYPE GERMANIUM, by L. J. Neuringer. [1965] [7]p. incl. diagrs. table. refs. (AFOSR-65-1763) (AF 19(604)7344) AD 625757 Unclassified

Also published in Proc. Seventh Internat'l. Conf. on Semiconductor Phys., Paris (France) (July 19-24, 1964), p. 379-385.

A quantitative analysis is made of the dependence of the longitudinal saturation magnetoresistance upon the strength of the impurity scattering in n-type germanium at 77°K. Measurements of the longitudinal magnetoresistance and Hall coefficient are performed as a function of magnetic field to 130 kg, and the conductivity mobility is determined by the mixed lattice and impurity scattering. The classical strong-field theory of Herring and Vogt and the Born approx are found to be in agreement with experimental results. The overall relaxation time anisotropy is found to be greater than unity for all samples studied and is 1.23 in the case of pure lattice scattering. The conductivity mobility for pure lattice scattering is given a value of 4.1 x 10^4 cm^2/V-sec.

1539

Massachusetts Inst. of Tech. National Magnet Lab.,
Cambridge.

TWO PHASE FLOW IN CAPILLARY TUBES, by M.
Suo and P. Griffith. Mar. 1963, 77p. incl. diagrs.
refs. (Technical rept. no. 8581-24) (AF 19(604)7344)
AD 402012   Unclassified

The flow of two phases, gas and liquid, has been
studied in horizontal tubes of capillary diameter. The
flow has been primarily studied in the regime where the
gas flows as long bubbles separated from the wall of the
tube by a liquid film and from each other by slugs of
liquid. In this regime, the pressure drop, density and
the thickness of the liquid film around a bubble have
been correlated. The conditions under which the long
bubble flow can exist and under which the correlations
are valid have been determined. Of special interest
is that the correlations should be valid in a zero-gravity
field.

1540

Massachusetts Inst. of Tech. National Magnet Lab.,
Cambridge.

BAND STRUCTURE AND MAGNETISM OF GADOLINI-
UM METAL, by J. O. Dimmock and A. J. Freeman.
[1964] [3]p. incl. diagrs. refs. (AFOSR-65-0605)
(AF 49(638)1468) AD 614557   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 750-752,
Dec. 21, 1964.

Some results of a nonrelativistic augmented plane
wave calculation of the electronic energy bands in
gadolinium metal are reported. The calculated conduc-
tion bands differ markedly from those of the free-elec-
tron model, and instead closely resemble those of the
transition metals. This is due to the fact that bands
originating from atomic 5d and 6s states overlap and
are strongly mixed. The bands near the Fermi surface
are of mixed s-d character and yield a density of states
about 3 times that given in the free-electron model.

1541

Massachusetts Inst. of Tech. National Magnet Lab.,
Cambridge.

ALFVÉN-WAVE PROPAGATION IN PYROLYTIC AND
SINGLE-CRYSTAL GRAPHITE, by M. Surma, J. K.
Furdyna, and H. C. Praddaude. [1964] [3]p. incl.
diagrs. (AFOSR-65-0606) (AF 49(638)1468)
AD 615364   ·   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 710-712,
Dec. 14, 1964.

Alfvén-wave propagation has recently been observed in
bismuth and antimony. An investigation was made of
the phenomenon in pyrolytic graphite (PG), which
afforded the possibility of investigating the unique be-
havior of Alfvén waves in an almost 2-dimensional

plasma. The experiments were carried out at 4.2°K
with a 35-Gc/sec absorption cavity spectrometer. The
results are in good agreement with the anisotropy of the
Fermi surface of graphite. The carrier density, esti-
mated on the basis of these measurements using
Shubnikov-de Haas effective masses for the basal plane,
is $3.3 \times 10^{24}/m^3$ for each carrier. In the low-field
region, cyclotron resonance was observed in both PG
and single-crystal graphite.

1542

Massachusetts Inst. of Tech. National Magnet Lab.,
Cambridge.

HIGH FIELD MAGNETIC MOMENT AND ANTIFERRO-
MAGNETIC RESONANCE MEASUREMENTS IN
α-Fe_2O_3, CoF_2, FeF_2 AND $(MnF_2)_{1-x}(ZnF_2)_x$, by S.
Foner. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-
1981) (AF 49(638)1468) AD 626329   Unclassified

Also published in Proc. Internat'l. Conf. on Magnetism
Nottingham (Gt. Brit.) (Sept. 7-11, 1964), 1964, p. 438-
442.

Pulsed field measurements of the spin-flop transition
in natural single crystal α-Fe_2O_3 are presented for T =
4.2 to 250°K, and brief comments are made on related
antiferromagnetic resonance experiments. The value
of H_c = 65 ± 3 kgauss for α-Fe_2O_3 for low temperatures
leads to an anisotropy field which is about 1/50 of the
dipolar anisotropy and is much smaller than previously
estimated. It is suggested that high field reversal of
memory in polycrystalline α-Fe_2O_3 reflects the spin-
flop phenomenon. Free energy contributions of spon-
taneous moments to the critical field are discussed.
Results of magnetic susceptibility, antiferromagnetic
resonance and spin-flop in two compositions of $(MnF$
$(MnF_2)_{1-x}(ZnF_2)_x$ are also briefly presented. (Contrac-
tor's abstract, modified)

1543

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

OPTIMUM NOISE PERFORMANCE OF MULTITER-
MINAL AMPLIFIERS, by W. D. Rummler. Feb. 1,
1964, 124p. incl. diagrs. refs. (Technical rept. no.
417) (AFOSR-64-0700) (DA 36-039-AMC-03200(E))
                                            Unclassified

A measure is determined of the optimum noise per-
formance of a linear multiterminal-pair amplifier; this
optimum performance is achieved with a multiterminal-
pair source in a narrow band of frequencies Δf at a
single-output terminal pair. The optimum noise per-
formance of such a system is defined as the maximum
signal-to-noise ratio achievable at large exchangeable
signal power. It is shown that this is a meaningful
criterion for any system that is to deliver ultimately an
amount of signal power considerably greater than
$kT_0\Delta f$, the noise power available from a resistor at a
temperature T_0. The techniques described can be

used to determine the maximum signal-to-noise ratio achievable at any value of exchangeable (or available signal power. The results are presented in a plot with noise-to-signal ratio and the reciprocal of exchangeable signal power as coordinates—the noise-performance plane. The noise figure, exchangeable-power gain, and noise measure are given a geometrical interpretation in this plane. (Contractor's abstract, modified)

1544

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A STUDY OF THE PERFORMANCE OF LINEAR AND NONLINEAR FILTERS, by V. R. Algazi. June 22, 1964, 104p. incl. diagrs. refs. (Technical rept. no. 420) (DA 36-039-AMC-03200(E)) AD 601875
Unclassified

A measure of the performance of filters is proposed which compares the filter under study to an optimum attenuator acting on the same input. The noise level (noise-to-message power ratio) is emphasized as an independent parameter important to the behavior and the performance of both linear and nonlinear filters. For optimum and nonoptimum linear filters, the effect of the noise level on the performance is the specific object of study. For nonlinear no-memory filters after considering the determination of the optimum filter for mean-square and non mean-square criteria, the characteristics of the message and the noise are investigated for which the optimum mean-square filter reduces to an attenuator. (Contractor's abstract, modified)

1545

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELECTROMAGNETIC INDUCTION ON AN EXPANDING CONDUCTING SPHERE, by L. C. Bahiana. May 30, 1964, 71p. incl. diagrs. refs. (Technical rept. no. 421) (AFOSR-64-1363) (DA 36-039-AMC-03200(E)) AD 602435
Unclassified

The major part of the work reported here is concerned with the case of a perfectly conducting expanding sphere. This problem is solved rigorously with the help of an integral equation relating the current density to the magnetic vector potential. The fields are determined in integral form for any arbitrary velocity of expansion, and calculated explicitly for the particular case of constant velocity of expansion. The physical interpretation of these solutions is discussed. The electromagnetic force acting on the sphere is found, and the energy-power balance at the surface of the sphere is investigated with the help of Poynting's theorem. The case of the expanding sphere with finite conductivity is formulated, but exact solutions are not given. A rough calculation of the expected electric field 1000 km from a typical nuclear explosion shows that the field is measurable, and its value is of the same order of magnitude as that predicted by another proposed theory.

1546

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CODING COLOR PICTURES, by U. F. Gronemann. June 17, 1964, 41p. incl. illus. diagrs. tables, refs. (Technical rept. no. 422) (AFOSR-64-1364) (DA 36-039-AMC-03200(E))
Unclassified

A computer-simulation study of efficient coding for color pictures has been undertaken. Two typical color transparencies were resolved into 3 primaries, sampled in a square array and recorded digitally on magnetic tape. The computer program transformed these data into luminance and chrominance quantities, performed certain parameter modifications, reconverted them into primary-color quantities and wrote them on an output tape. The output tape was played back through the recorder-reproducer to produce images of the coded pictures on the face of the cathode-ray tube, which were photographed through appropriate filters on color film. The resultant transparencies were later viewed and compared by a number of observers. Two major conclusions were drawn: (1) A normal monochromatic picture can be converted into a full color picture of the same apparent sharpness by transmitting additionally only a fraction of a bit per sample; and (2) Inclusion of color may result in an over-all lower transmission rate requirement than would the same picture coded monochromatically. For some purposes, such as recognizing objects, this reduction can be substantial. (Contractor's abstract, modified)

1547

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A MODEL FOR FIRING PATTERNS OF AUDITORY NERVE FIBERS, by T. F. Weiss. Mar. 2, 1964, 93p. incl. diagrs. table refs. (Technical rept. no. 418) (AFOSR-64-1367) (DA 36-039-AMC-03200(E))
Unclassified

Recent electrophysiological data obtained from auditory nerve fibers of cats have made possible the formulation of a model of the peripheral auditory system. This model relates the all-or-none activity of these fibers to acoustic stimuli. The constituents of the model are intended to represent the major functional constituents of the peripheral system. These constituents are: (1) a linear mechanical system intended to represent the outer, middle, and the mechanical part of the inner ear; (2) a transducer intended to represent the action of the sensory cells; and (3) a model neuron intended to represent the nerve excitation process. A general-purpose digital computer has been used to determine the response of the model to a variety of acoustic stimuli. These results have been compared with data obtained from auditory nerve fibers. (Contractor's abstract)

1548

Massachusetts Inst. of Tech. Research . of
Electronics, Cambridge.

NOTE ON SHORT TERM STORAGE OF INFORMATION
IN VISION, by M. Eden. [1964] [2]p. (AFOSR-64-1574)
(DA 36-039-AMC-03200(E)) AD 444392
Unclassified

Also published in Perceptual and Motor Skills, v. 19:
93-94, 1964.

A reevaluation of the short term memory experiments
of Averbach and Sperling furnishes evidence that the
memory read-out is linear. (Contractor's abstract)

1549

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

EXPERIMENTS ON COMPUTER RECOGNITION OF
CONNECTED HANDWRITTEN WORDS, by P.
Mermelstein and M. Eden. [1964] [16]p. incl. diagrs.
table. (AFOSR-64-1575) (DA 36-039-AMC-03200(E))
AD 444394
Unclassified

Also published in Inform. and Control, v. 7: 255-270,
June 1964.

An operational system is presented for the recognition
of handwritten words when written on line on a special
transducer. The system represents a new approach to
handwriting recognition, that of searching for the in-
variants of the patterns of consideration of the intrinsic
movements that execute the handwriting. Experiments
carried out by computer simulation of the recognition
system reveal that the system is capable of recognizing
well-informed, legible handwritten words with a relia-
bility that depends on the correspondence between the
script of the test samples and that of the ensemble on
which the machine's representation of handwriting is
based. (Contractor's abstract, modified)

1550

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

RESPONSES OF SINGLE UNITS IN THE AUDITORY
CORTEX, by G. L. Gerstein and N. Y.-S. Kiang.
[1964] [18]p. incl. diagrs. refs. (AFOSR-64-1576)
(DA 36-039-AMC-03200(E)) AD 444393
Unclassified

Also published in Exper. Neurol., v. 10: 1-18, July
1964.

The temporal firing patterns of units in the auditory
cortex were studied as a function of stimulus parame-
ters. Different units exhibit a wide variety of response
patterns for the same stimulus. A particular unit may
exhibit different response patterns to different stimuli.
(Contractor's abstract, modified)

1551

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

TRAVELING DENSITY VARIATIONS IN PARTIALLY
IONIZED GASES, by R. S. Cooper. Sept. 2, 1964, 79p.
incl. diagrs. tables, refs. (Technical rept. no. 424)
(AFOSR-64-1910) (DA 36-039-AMC-03200(E))
AD 606220
Unclassified

The report deals with the problem of the propagation of
macroscopic waves of ionization within the positive
column of glow discharge tubes. In the literature of this
field these waves have been called 'moving striations'
because of the visible radiation emanating from the
traveling pulse. Both experimental and theoretical
analyses of this phenomenon were made. The principal
experimental result of this work is the establishment of
a linear regime of operation for the observed traveling
waves and the artificial excitation of them. The princi-
pal theoretical result is the derivation and the analysis
of a linear theory that is applicable to the experimental
regime of operation. (Contractor's abstract)

1552

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

INFRARED STUDIES OF PEROVSKIT TITANATES, by
C. H. Perry, B. N. Khanna, and G. Rupprecht. [1964]
[5]p. incl. diagrs. tables, refs. (AFOSR-64-2140)
(DA 36-039-AMC-03200(E)) Unclassified

Also published in Phys. Rev., v. 135: A408-A412,
July 20, 1964.

The infrared reflection and transmission spectra of
$CaTiO_3$, $SrTiO_3$, and $PbTiO_3$ have been measured from
4000 to 30 cm^{-1} at room temperature. The reflection
data obtained from transmission spectra. Three
infrared active vibrations were observed for cubic
$SrTiO_3$ as required by group theory. However, in the
case of $CaTiO_3$ and $PbTiO_3$, which crystallize bands
were found which had not been observed previously.
These distortions from ideal cubic symmetry would
split degenerate modes to possibly give additional
frequencies. The results are compared with those of
other workers. (Contractor's abstract, modified)

1553

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

MAGNETOHYDRODYNAMIC POWER GENERATION—A
STATUS REPORT, by W. D. Jackson. [1964] [6]p.
incl. diagrs. table, refs. (AFOSR-64-2141) (DA 36-
039-AMC-03200(E)) AD 447457
Unclassified

Also published in Jour. Electron. Power, v. 10: 258-
263, Aug. 1964.

This report gives the htstortc and theoretical back-
ground to the development of m. h. d. power generation
and sruveys promtsing recent appltcations such as
topping devices and space-vehicle power systems.

1554

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

EVOKED RESPONSES FROM THE AUDITORY CORTEX,
by D. C. Teas and N. Y.-S. Kiang. [1964] [29]p. incl.
diagrs. refs. (AFOSR-64-2142) (DA 36-039-AMC-
03200(E))   Unclassified

Also published in Exper. Neurol., v. 10: 91-119,
Aug. 1964.

Evoked responses were recorded from the auditory
cortex of unanesthetized cats. With clicks of moderate
intensity, the waveforms of the responses were highly
repeatable among awake cats. Introduction of certain
variables such as localized injury to cortex, anesthesia,
or sleep resulted in more or less characteristic changes
in the waveform of the evoked responses. In particular,
the later components of the responses seemed to be
more sensitive to changes tn the state of the animal,
while the early components seemed to be abolished by
local injury to the cortex. The evoked responses and
particularly the later components did not always behave
in a reliably repeatable fashion as click intensity or
click rate was changed. When broad-band background
noise was introduced, the click evoked responses al-
ways showed a characteristic decrease in the earltest
component. These results are tnterpreted in terms of
multiple projection pathways to cortex with possible
functional significance. (Contractor's abstract,
modified)

1555

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

A PRELIMINARY EXPERIMENT ON THE PERCEPTUAL
BASIS FOR MUSICAL INSTRUMENT FAMILIES, by M.
Clark, Jr., P. Robertson, and D. Luce. [1964] [5]p.
tncl. diagrs. tables. (AFOSR-64-2144) (DA 36-039-
AMC-03200(E))   Unclassified

Also published in Jour. Audio Eng. Soc., v. 12,
July 1964.

Expertmental evidence is presented for the evtdence of
perceptual families of instruments. This evidence ts
the result of confusions in identifying the instruments
that produced tones when these tones were played back
at speeds htgher than that at which they were recorded.
The strtng famtly consists of violins, violas, cellos,
and double basses. The brass family consists of trum-
pets, trombones, tubas, and French horns. The double
reed family cor.ststs of oboes, English horns, and
bassoons, wtth the bassoons only very weakly linked to
the other members of tta famtly. The famtlies are
listed in order of decreasing tightness. Very tight sub-

famtlities are formed of the following pairs: violtn-
viola, cello-double bass, oboe-Engltsh horn, trumpet-
trombone. (Contractor's abstract)

1556

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

SUPERPOSITION IN A CLASS OF NONLINEAR SYS-
TEMS, by A. V. Oppenheim. [1964] [7]p. incl. diagrs.
(AFOSR-64-2146) (DA 36-039-AMC-03200(E))
AD 448383   Unclassified

Also published tn IEEE Internat'l. Conv. Rec., Part 1:
171-177, 1964.

The ease of analysis and characterization of ltnear sys-
tems stems primarily from the fact that they satisfy the
principle of superposition. A generalization of the
prtnctple of superposition ts presented and the class of
nonltnear systems that satisfy this generalized principle
is discussed. A canonical representation for systems tn
thts class ts derived, whtch consists of a cascade of 3
systems, the first and last of whtch are dependent upon
a general property of the system tnputs and outputs, re-
spectively. The second system tn the canonical repre-
sentation ts a linear system. Appltcations of the theory
are considered for a class of nonltnear feedback systems.
(Contractor's abstract)

1557

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

ON THE OPTIMUM QUANTIZATION OF STATIONARY
SIGNALS, by J. D. Bruce. [1964] [7]p. tncl. diagrs.
table. (AFOSR-64-2147) (DA 36-039-AMC-03200(E))
                                        Unclassifted

Also publtshed tn IEEE Internat'l. Conv. Rec., Part 1:
118-124, 1964.

The exact expression for the quantization error as a
function of the parameters that define the quantizer, the
error-weighting function, and the amplitude probability
density of the quantizer-input signal is presented. An
algorithm ts developed that permtts the determtnation
specific values of the quantizer parameters that define
the optimum quantizer. This algor.thm, whtch is based
on a modified form of dynamtc programmtng, is valid
for both convex and nonconvex error-wetghting functions.
Examples of optimum quantizers destgned with this
algorithm for a representative speech sample are pre-
sented. The performance of these quantizers is com-
pared with that of the unlform quantizer. (Contractor's
abstract)

1553

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

THEORY OF RADIATION EMISSION AND ABSORPTION

IN PLASMA, by T. H. Dupree. [1964] [18]p. incl. table. (AFOSR-64-2148) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Phys. Fluids, v. 7: 923-940, July 1964.

Starting with the basic plasma kinetic equations correct to second order in the plasma parameter, general formulas for cyclotron and bremsstrahlung emission and absorption are derived. The theory provides a rigorous description of the interaction of plasma and radiation. At equilibrium, Kirchhoff's law is recovered and the theory reduces to previously derived results. (Contractor's abstract)

1559

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A MULTIUSER COMPUTATION FACILITY FOR EDUCATION AND RESEARCH, by J. B. Dennis. [1964] [9]p. incl. diagrs. (AFOSR-64-2282) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Commun. Assoc. Computing Mach., v. 7: 521-529, Sept. 1964.

Implementation is described for a small-scale multi-user computer system that permits several users to work independently with the machine, and to obtain satisfactory response using typewriter communication.

1560

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NOTE ON RECURRENT CODES, by E. R. Berlekamp. [1964] [2]p. (AFOSR-64-2283) (DA 36-039-AMC-03200(E)) AD 450890 Unclassified

Also published in IEEE Trans. Inform. Theory, v. IT-10, July 1964.

Wyner and Ash have given bounds on the minimum guard space necessary to correct all bursts of a specified maximum length with a recurrent code. Following the methods of a previous paper, this communication gives an explicit construction for achieving their lower bound for recurrent codes designed to correct error bursts of a known phase.

1561

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STATISTICAL THEORY OF SPIN-SPIN INTERACTIONS IN SOLIDS, by W. J. C. Grant and M. W. P. Strandberg. [1964] [12]p. incl. refs. (AFOSR-64-2284) (DA 36-039-AMC-03200(E) and DA 36-039-sc-87376) AD 450889 Unclassified

Also published in Phys. Rev., v. 135: A715-A726, Aug. 3, 1964.

A statistical theory of spin interactions is presented which takes its starting point from pair transitions rather than single-particle transitions. The approach through straightforward perturbation theory applied to pairs, and the approach through the time development of the pair-transition operator $S_x(t)$ are shown to be equivalent. The averaging over possible pair configurations is performed by means of a weight function which allows inclusion of the details of the lattice structure and of departures from random spin distribution. Concentration dependence and temperature dependence appear naturally in the formalism. The formalism is not intrinsically restricted to a particular type of spin interaction. The existence of asymmetry in certain line shapes is indicated. The theory is applied to magnetic dipole interaction and exchange. (Contractor's abstract, modified)

1562

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LINE SHAPES OF PARAMAGNETIC RESONANCES OF CHROMIUM IN RUBY, by W. J. C. Grant and M. W. P. Strandberg. [1964] [13]p. incl. diagrs. tables, refs. (AFOSR-64-2285) (DA 36-039-AMC-03200(E) and DA 36-039-sc-87376) AD 450887 Unclassified

Also published in Phys. Rev., v. 135: A727-A739, Aug. 3, 1964.

Using the formalism of the preceding paper, detailed numerical calculations are performed for the line shapes of paramagnetic resonances of chromium in ruby. It is found that (1) the dipolar line departs only slightly from the Lorentzian at the highest attainable concentrations, (2) the line is predominantly nondipolar at low concentrations, (3) no inference is possible from moments as to the magnitude or parametric behavior of intensities and half-widths, (4) neither exchange nor clustering of impurities affect the line shape at low concentrations, and (5) exchange cannot narrow the $(\frac{1}{2}, -\frac{1}{2})$ transition. Various explanations for the observed residual width at vanishing concentrations are discussed in the light of these findings. (Contractor's abstract)

1563

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LOCAL, SEGMENTAL AND SUPRASPINAL INTERACTION WITH A DORSOLATERAL SPINAL CUTANEOUS AFFERENT SYSTEM, by A. Taub. [1964] [18]p. incl. illus. diagrs. refs. (AFOSR-64-2288) (AF AFOSR-64-591 and DA 36-039-AMC-03200(E)) AD 450891 Unclassified

Also published in Exper. Neurol., v. 10: 357-374, Oct. 1964.

This report deals with the spinocervical tract and
with the effects of the electrical stimulation of cerebellar nuclear and brain-stem structures upon the receptive
field response characteristics of its single units. Its
primary purpose is to describe the constriction of the
cutaneous light tactile excitatory receptive field obtained by such stimulation and to demonstrate a possible
underlying presynaptic mechanism. In addition, a novel
form of afferent inhibition by mechanical and thermal
stimulation is described, and some intersegmental inhibition patters are discussed.

1564

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

EXCITATION OF ION OSCILLATIONS IN BEAM-PLASMA SYSTEMS, by M. T. Vlaardingerbroek.
Sept. 18, 1964, 31p. incl. diagrs. refs. (Technical
rept. no. 426) (AFOSR-64-2289) (DA 36-039-AMC-03200(E)) AD 607269   Unclassified

This report suggests possible ways for further theoretical study of the interaction of an electron beam and
the ions in a hot-electron plasma. Equations are obtained for beam-plasma interaction in a filled cylindrical
waveguide in which the thermal velocity distribution is
longitudinal but otherwise arbitrary. An approximation
is described based on these equations by using only one
transverse wave number. Beam- (hot-electron) plasma
interaction is calculated including a transverse random
velocity distribution. The theory of a filamentary
beam and a plasma-filled waveguide are combined,
using the coupling-of-modes theory, for the description
of some of the weak interactions between a thin beam
and a finite plasma. (Contractor's abstract, modified)

1565

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

RADIO OBSERVATIONS OF VENUS AND THE
INTERPRETATIONS, by A. H. Barrett and D. H.
Staelin. [1964] [27]p. incl. diagrs. tables, refs.
(AFOSR-64-2356) (DA 36-039-AMC-03200(E))
AD 451341   Unclassified

Also published in Space Sci. Rev., v. 3: 109-135, 1964.

The radio observations of Venus are reviewed and compared with theoretical microwave spectra computed for
a variety of models of the Venusian environment. The
models considered are (a) a CO_2-N_2 atmosphere, (b) an
atmosphere of dust (the aeolosphere model), and (c) a
cloud model with various loss mechanisms in the cloud.
The effect of polarization on the surface emissivity has
been included in all the computations. It is shown how
the radio observations place limits upon the acceptable
models. It is shown how some models place severe
restrictions on radar observations at short centimeter
wavelengths, thereby emphasizing the importance of
such experiments. (Contractor's abstract)

1566

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

ORBIT STABILITY IN A HELICALLY PERTURBED
MAGNETIC FIELD, by L. M. Lidsky. [1964] [5]p.
incl. diagrs.   (AFOSR-64-2357) (DA 36-039-AMC-03200(E))   Unclassified

Also published in Phys. Fluids, v. 7: 1484-1488, Sept.
1964.

The stability of particle orbits in resonant helices
("corkscrews") is investigated for axial acceleration
and deceleration of the injected particles. It is shown
that deviations from the unperturbed orbit lead to
growing oscillations about that orbit for a decelerating
corkscrew. The growth rate is small in devices suitable
for injection into mirror fields. The numerical results
are in agreement with experimental observations of injection parameters and output properties. Deviations
from the equilibrium orbit in an accelerating corkscrew
lead to damped oscillations. (Contractor's abstract)

1567

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

DEVELOPMENT OF A LARGE-VOLUME SUPER-CONDUCTING SOLENOID, by L. J. Donadieu. Oct. 16,
1964, 131p. incl. illus. diagrs. tables, refs. (Technical rept. no. 427) (AFOSR-64-2455) (DA 36-039-AMC-03200(E)) AD 608445   Unclassified

Problems encountered in the development of large-volume superconducting solenoids have been investigated
in the light of the experience induced by the realization
of a particular prototype (8.0 in. in diam., 4 ft long,
20 kilogauss at room temperature). The current-field
characteristics of some useful superconducting materials
(Nb, Mo-Re, Nb-Zr) have been measured; the results
are discussed in terms of recent theories of superconductors. The spurious loss of the resistanceless state
of a superconducting solenoid, which is particularly
dangerous for large-volume devices, was thoroughly
investigated. Results of calculations for the prototype
solenoid are presented. The design of the prototype
solenoid, is thoroughly detailed. The most important
topics covered: field calculation for multicoil solenoids;
magnetic stresses and magnetic energy; quenching
process for multicoil solenoids; steady-state heat transfer caused by residual gas, thermal radiation and conduction; and transient heat transfer. (Contractor's
abstract, modified)

1568

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

RELAXATION SPECTRA OF RIBONUCLEASE. I. THE
INTERACTION OF RIBONUCLEASE WITH CYTIDINE

3'-PHOSPHATE, by R. E. Cathou and G. G. Hammes. [1964] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-64-2456) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3240-3245, Aug. 20, 1964.

Kinetic studies of the interaction of bovine pancreatic ribonuclease with cytidine 3'-phosphate have been made at high enzyme concentrations ($> 10^{-5}$ M) using the temperature jump method. Two different relaxation processes with characteristic relaxation times ranging from about 1 msec to less than 20 μ sec have been observed. One process is concentration dependent and is observed at all pH's in the range studied (pH 5.0-7.5). This effect is due to the formation of the enzyme—substrate complex; the rate constants for both complex association and dissociation were determined and interpreted in terms of elementary mechanistic steps involving an enzyme group with a pK of 6.7 in the free enzyme. The other relaxation process is observed only when the enzyme is essentially all in the form of the enzyme-cytidine 31-phosphate complex. The relaxation time is concentration independent, suggesting an intramolecular process. (Contractor's abstract, modified)

1569

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EVOKED RESPONSES IN RELATION TO VISUAL PERCEPTION AND OCULOMOTOR REACTION TIMES IN MAN, by J. S. Barlow. [1964] [36]p. incl. illus. diagrs. tables, refs. (AFOSR-64-2458) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Ann. New York Acad. Sci., v. 112: 432-467, May 8, 1964.

Results are described and discussed from experiments in which responses evoked by visual stimuli are studied in relation to oculomotor reaction times, and in relation to some of the phenomena associated with visual perception.

1570

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A NOTE ON ASYMMETRY IN PHRASE STRUCTURE GRAMMARS, by G. H. Matthews. [1964] [6]p. (AFOSR-64-2459) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Inform. and Control, v. 7: 360-365, Sept. 1964.

The author (1963) defined several classes of grammars and determined their generative power. These grammars are defined partially by the form of their rules and partially by the form of the derivations of the sentences they generate. That paper shows that one-way grammars and one-way discontinuous grammars are equivalent to context-free grammars as defined by Chomsky (1959). This paper shows that the restrictions on the form of the rules are not essential; any unrestricted rewriting system generates a context-free language if its derivations are confined to one-way derivations as defined by Matthews (1963).

1571

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TRANSISTOR BECOMES SENSOR IN TEMPERATURE REGULATOR, by S. Greenblatt. [1964] [1]p. incl. diagr. (AFOSR-64-2460) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Electronics, v. 37, Nov. 2, 1964.

A simple temperature-control circuit was constructed by taking advantage of the predictable variation of transistor parameters with temperature. The construction is detailed and a schematic diagrm is included.

1572

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PRESYNAPTIC HYPERPOLARIZATION: A ROLE FOR FINE AFFERENT FIBRES, by L. M. Mendell and P. D. Wall. [1964] [21]p. incl. illus. diagrs. refs. (AFOSR-65-0020) (DA 36-039-AMC-03200) AD 452860 Unclassified

Also published in Jour. Physiol., v. 172: 274-294, 1964.

This paper provides evidence that the presynaptic control mechanism is in continuous operation and that arriving nerve impulses may either increase of decrease the membrane potential of neighboring fibers and, therefore, may either facilitate or inhibit presynaptically. Experiments are described in spinal cats which show that the steady arrival of cutaneous impulses at the cord results in a steady depolarization of passive afferent terminals. By the use of a method for preferential blocking of large fibers by anodal polarization, it is shown that impulses in fine fibers produce a hyperpolarization of the terminals of large fibers. This effect is blocked by barbiturate. If terminals are held steadily depolarized, the arrival of impulses in A fibers hyperpolarizes the terminals of passive neighbors. Positive dorsal root potentials are associated with hyperpolarization of the terminals of large diameter cutaneous fibers. C fiber volleys hyperpolarize the terminals of cutaneous A fibers and facilitate the reflex evoked by the A fibers.

1573

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NOTE ON BINAURAL MASKING-LEVEL DIFFERENCES AS A FUNCTION OF THE INTERAURAL CORRELATION

OF THE MASKING NOISE, by N. I. Durlach. [1964] [5]p. incl. diagr. refs. (AFOSR-65-0021) (DA 36-039-AMC-03200(E)) AD 452859   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 1613-1617, Sept. 1964.

A quantitative 'black-box' model is constructed for interpreting data that describe the dependence of binaural masked thresholds on the proportion of common noise in the masking signals. This model is a natural adjunct to the equalization-and-cancellation model, discussed in previous papers. (Contractor's abstract)

1574

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANALYSIS OF ELECTRON BEAM-PLASMA SYSTEMS, by P. E. Serafim. July 31, 1964, 96p. incl. diagrs. table, refs. (Technical rept. no. 423) (AFOSR-65-0022) (DA 36-039-AMC-03200(E)) AD 609023   Unclassified

The interaction between an electron beam and a plasma in metallic waveguides and in the presence of an external longitudinal magnetostatic field is analyzed. Plasma ions and electrons are considered. The treatment is valid for slow and fast waves and for relativistic beam velocities. In the first part an exact analysis is made of the beam-plasma waveguide based on the linearized Maxwell equations and the Lorentz force equation. The "operator" dielectric tensor description of the beam-plasma medium is introduced. The properties of this tensor are examined and the boundary conditions are formulated in terms of the elements of this tensor. In the second part, a solution of the plasma waveguide problem by a coupling-of-modes theory is given. The results are specialzied for plasma waveguides, and the case of a completely filled circular plasma waveguide is examined in detail. (Contractor's abstract, modified)

1575

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DETERMINATION OF NEUTRAL GAS TEMPERATURE IN A PLASMA COLUMN FROM SOUND VELOCITY MEASUREMENTS, by K. W. Gentle and U. Ingard. [1964] [2]p. incl. diagrs. (AFOSR-65-0025) (DA 36-039-AMC-03200(E)) AD 452454; AD 453584   Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 105-106, Sept. 1, 1964.

The temperature of the neutral gas component in a glow discharge plays a significant role in experiments involving the influence of gas flow on the properties of the discharge. An ordinary Langmuir probe, properly biased, is a simple means for the detection of sound in a discharge. The sound speed is obtained directly from the measured travel time of a sound pulse between

two such probes inserted in a plasma column. In this experiment the acoustic signal is produced in the neutral gas, 40 cm from the plasma column, by a spark sound source. As has frequently been noted, the wave produced by a spark of this type travels with the small-signal sound velocity outside a small region about the source.

1576

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

POLARIZATION EFFECTS ON MAGNETIC RESONANCES IN FERROELECTRIC POTASSIUM TANTALATE, by S. H. Wemple. Dec. 31, 1964, 83p. incl. illus. diagrs. tables, refs. (Technical rept. no. 425) (AFOSR-65-0254) (DA 36-039-AMC-03200(E)) AD 609911   Unclassified

Electric field effects on electron paramagnetic resonances (EPR) associated with Fe^{3+} impurity ions in the perovskite ferroelectric $KTaO_3$ are presented. A large effect (D = 30 x 10^{-4} cm^{-1} for E = 14 kv/cm) was predicted and observed at 4.2°K. The effect is several orders of magnitude larger in $KTaO_3$ than has been reported for other centrosymmetric lattices. The EPR angular dependence data for the Fe^{3+} ion in a cubic environment are interpreted in terms of appropriate spin Hamiltonian parameters. The result is $|\sigma|$ = (345 ± 10) x 10^{-4} cm^{-1} and g = 1.09 ± 0.01. The EPR spectra for Fe^{3+} ions having a neighboring oxygen vacancy, and for Fe^{5+}, Mn, and Cr are also reported. A method for growing fairly large (~1 cm^3) and good quality single crystals of $KTaO_3$ is described. (Contractor's abstract, modified)

1577

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELECTRON-STREAM INTERACTION WITH PLASMAS, by R. J. Briggs. Cambridge, M.I.T. Press, 1964, 187p. incl. diagrs. refs. (Special technical rept. no. 10) (AFOSR-65-0255) (DA 36-039-AMC-03200(E)) AD 454587   Unclassified

This study considers the instabilities that result when an electron beam is injected into a plasma. A number of different models of the system are considered, and all instabilities are classified according to whether they are convective instabilities (amplifying waves) or nonconvective (absolute) instabilities. The study also analyzes the instabilities in unbounded beam-plasma systems and in systems of finite extent transverse to the electron stream and gives a detailed consideration of the possibility of a strong interaction with the ions in a hot-plasma. In addition, a mathematical criteria is presented for identifying absolute instabilities and amplifying waves. These criteria are based only on an analysis of the dispersion equation of the system and are not restricted to beam-plasma systems.

1578

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

RESPONSES TO ACOUSTIC STIMULI FROM SINGLE
UNITS IN THE EIGHTH NERVE OF THE GREEN FROG,
by M. B. Sachs. [1964] [3]p. incl. diagrs. (AFOSR-
65-0267) (DA 36-039-AMC-03200(E)) AD 454011
Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36:
1956-1958, Oct. 1964.

Single-unit activity was recorded from the eighth nerve
of the green frog. All units are frequency-selective.
Units most sensitive to tone bursts of frequencies below
450 cps show little or no spontaneous activity; their
responses to tone bursts can be inhibited by tones of
frequency above 500 cps. Many of these low-frequency
units are sensitive to vibration and their responses
to vibration can also be inhibited. Units with most
sensitive frequencies above 650 cps are spontaneous
and cannot be inhibited. Ten units displaying very dif-
ferent response patterns are also discussed. (Con-
tractor's abstract, modified)

1579

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

THE DETECTION OF THE OH AND OTHER MOLECU-
LAR LINES IN THE RADIO SPECTRUM OF THE IN-
TERSTELLAR MEDIUM, by A. H. Barrett. [1964]
[10]p. incl. diagrs. tables, refs. (AFOSR-65-0268)
(DA 36-039-AMC-03200(E)) AD 454004
Unclassified

Also published in IEEE Trans. on Military Electron.,
v. MIL-8: 156-165, July-Oct. 1964.

The nature of Λ-doublet levels are reviewed in an at-
tempt to clarify the origin of the OH lines. The results
of the OH observations are presented and the distinc-
tion between absorption and emission experiments is
discussed in terms of the importance for the OH lines.
The frequencies of the astrophysically important OH
transitions in various molecular states and isotopic
species are given and their detection possibilities are
briefly discussed. Radio molecular lines of SH, SiH,
CH, CN, and NH are also discussed. (Contractor's
abstract, modified)

1580

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

SPECTRUM AND RELATIVE INTENSITIES OF INTER-
STELLAR OH LINES, by A. H. Barrett and A. E. E.
Rogers. [1964] [2]p. incl. table, refs. (AFOSR-65-
0269) (DA 36-039-AMC-03200(E)) AD 454012
Unclassified

Also published in Nature, v. 204: 62-63, Oct. 3, 1964.

The frequencies, theoretical relative intensities and
transition probabilities of 14 microwave lines of various
energy levels and isotopic species of OH are listed.
The relation of present observational data to some of
these parameters is briefly discussed.

1581

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

EFFECT OF GAS FLOW ON THE PROPERTIES OF A
PLASMA COLUMN, by K. W. Gentle, U. Ingard, and
G. Bekefi. [1964] [2]p. incl. diagrs. (AFOSR-65-
0270) (DA 36-039-AMC-03200(E)) AD 454010
Unclassified

Also published in Nature, v. 203: 1369-1370, Sept. 26,
1964.

This communication describes some effects of gas flow
on the properties of a weakly ionized d. c. discharge in
argon at pressures of 2-30 mm mercury, with discharge
currents of 15-200 m. amp, and gas flow velocities
ranging from zero to 1.5×10^4 cm/sec, corresponding
to a Mach number approximately 0.5.

1582

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

ALTERNATION OF RULES IN CHILDREN'S GRAMMAR,
by P. Menyuk. [1964] [9]p. incl. diagrs. table, refs.
(AFOSR-65-0360) (DA 36-039-AMC-03200(E))
Unclassified

Also published in Jour. Verbal Learning and Verbal
Behav., v. 3: 480-488, Dec. 1964.

The use of alternate restricted rules which do not pro-
duce completely well-formed structures) found in chil-
dren's grammar are analyzed in an attempt to present
an adequate description of increasing complexity in
grammar as children mature. Language samples were
obtained from 159 children ranging in age from 2 yr,
10 mos to 7 yr, 1 mo. Each child's language sample
was analyzed by means of a generative model of gram-
mar. The data indicate that increasing complexity is
not simply related to the acquisition and increased us-
age of more complex sentence types. Increasing com-
plexity is also dependent on children's improved abili-
ty to proceed from the application of the most general
rule in the formulation of a syntactic structure to the
increasingly differentiating rules, and then to the com-
plete ordered set needed for a particular structure.
(Contractor's abstract, modified)

1583

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

DISTRIBUTED SOLUTION OF NETWORK

PROGRAMMING PROBLEMS, by J. B. Dennis. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-0361) (DA 36-039-AMC-03200(E)) Unclassified

Also published in IEEE Trans. Commun. Systems, v. CS-12: 176-184, June 1964.

A method is presented for the solution of network programming problems through the iterative execution of the same algorithm for each station of the network. At a given station, the algorithm requires data only from adjacent stations of the network. The theory of the method is developed through the use of electrical models of network programming problems. The techniques should be useful for the communications message-routing problem and similar cases in which the disadvantages of relying on a computation performed at a master station must be avoided.

1584

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PSEUDORANDOM SCANNING, by T. S. Huang. [1964] [3]p. incl. diagrs. (AFOSR-65-0362) (DA 36-039-AMC-03200(E)) AD 611718 Unclassified

Also published in IEEE Trans. Commun. Technol., v. COM-12: 105-107, Sept. 1964.

The use of pseudorandom scanning is considered in the transmission of still picture through a 1-dimensional channel. It is shown that: (1) if the channel contains noise of a burst nature then pseudorandom scanning should give a better picture; and (2) in a low-pass channel pseudorandom scanning will add substantial noise to the picture even if the channel bandwidth is reasonably wide.

1585

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TRANSFORMATION OF SMALL-SIGNAL ENERGY AND MOMENTUM OF WAVES, by R. J. Briggs. [1964] [5]p. incl. diagrs. (AFOSR-65-0363) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Jour. Appl. Phys., v. 35: 3268-3272, Nov. 1964.

The transformation of the small-signal energy and momentum of a wave between two inertial reference frames as first given by Sturrock are derived by using simple perturbation theory and the appropriate transformations of length, time, current, and electromagnetic fields. The approach allows a straightforward generalization to the case of relativistic linear transformations to nonrelativistic transformations between two reference frames that rotate with respect to each other. These rotating and linear transformations allow one to make very general statements about the frequency and wave numbers for which negative-energy waves are

obtained in a rotating and translating medium, as, for example, an electron beam in Brillouin flow. (Contractor's abstract)

1586

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DIAGNOSTIC EXPERIMENTS IN A MAGNETICALLY DRIVEN SHOCK TUBE, by J. B. Heywood. Dec. 31, 1964, 57p. incl. illus. diagrs. tables, refs. (Technical rept. no. 428; Fluid Mechanics Lab. publ. no. 65-1) (AFOSR-65-0544) (DA 36-039-AMC-03200(E)) AD 610583 Unclassified

This report describes the results obtained from a series of experiments in hydrogen in a magnetic annular shock tube with an applied axial magnetic field. Measurements of the front speed were made over as wide a range of initial gas pressure, initial drive bank voltage, and axial magnetic field as possible. These results are compared with the predicted speeds obtained from the Kemp and Petschek solutions and the snowplow model, and reasonable agreement is obtained. Measurements were also made on the front properties with magnetic and electric field probes inside the annulus, and with phototubes. It was found that a substantial fraction of the drive current always flows in the front and no shock wave preceding the current sheet was observed. (Contractor's abstract, modified)

1587

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERTURBATION OF A PLASMA BY A PROBE, by J. F. Waymouth. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0545) (DA 36-039-AMC-03200(E)) AD 611641 Unclassified

Also published in Phys. Fluids, v. 7: 1843-1854, Nov. 1964.

The theory of the electrostatic probe immersed in a plasma is discussed under the assumptions that particle mean free paths are comparable with or smaller than probe radius. The range of validity of the results is for $\lambda_c/r_p < 10$, $r_p/100\lambda_D > 1$, $\lambda_c/\lambda_D > 10$, where r_p is probe radius, λ_c is particle mean free path, and λ_D is the Debye length. In the limit of λ_c/r_p approaching infinity, the results converge toward the Langmuir result for the same probe. The probe-current vs voltage characteristic obtained when mean free paths are short is distorted because the degree of perturbation of plasma density and potential vary with probe voltage. An unexpected result is that the shape of the probe characteristic in the vicinity of the "knee" is sensitive to ion temperature, and may possibly be used to determine the ion temperature. (Contractor's abstract)

1588

Massachusetts Inst. of Tech. [Research Lab. of
Electronics] Cambridge.

MEASUREMENT OF CORRELATION FUNCTIONS, by
M. Schetzen. [1964] [5]p. incl. diagrs. (AFOSR-65-
0546) (DA 36-309-AMC-03200(E)) AD 611947
Unclassified

Also published in Proc. IEEE (London), v. 111: 2100-
2104, Dec. 1964.

A practical and relatively simple method of measuring
correlation functions is presented. The method, which
is applicable to all orders of correlation functions, is
based upon orthogonal expansions. The application of
this method to the experimental determination of a 2nd-
order cross correlation function is discussed in detail
and some experimental results are presented. (Con-
tractor's abstract)

1569

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

NATURE OF SPONTANEOUS OSCILLATIONS IN A
CESIUM DIODE ENERGY CONVERTER, by W. T.
Norris. [1964] [9]p. incl. diagrs. (AFOSR-65-0547)
(DA 36-039-AMC-03200(E)) AD 611640
Unclassified

Also published in Jour. Appl. Phys., v. 35: 3260-
3268, Nov. 1964.

In an attempt to understand the nature of the oscilla-
tions that are observed in plasma diodes the usual
collision-free model is examined. The equations de-
scribing the model are simplified by neglecting the
time-dependent term in the Boltzmann equation for the
electrons. A criterion is introduced of stability which
allows the prediction of a possible instability in the
steady-state condition which arises because the elec-
trons can redistribute their charge more rapidly than
the ions. The simplified equations and the criterion to-
gether lead to a good qualitative and a partial quantita-
tive understanding of a particular case. (Contractor's
abstract, modified)

1590

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

EMITTER MATERIALS FOR HIGH TEMPERATURE
ENERGY CONVERSION, by W. B. Nottingham. [1964]
[15]p. incl. diagrs. tables, refs. (AFOSR-65-0610)
(DA 36-039-AMC-03200(E)) AD 451360; AD 452625
Unclassified

Presented at Proc. Eighteenth Annual Power Sources
Conf., May 19-21, 1964.

Also published in High Temp. Technol., 1964, p. 389-
403.

This report presents a number of pertinent points rela-
tive to the properties of materials, and specifically of
emission materials needed for the efficient operation of
a thermionic energy converter. Rasor (Proc. IEEE,
v. 51: 733, 1963) has made an analysis that shows that
rhenium and tungsten are the most favorable emitter
materials, and molybdenum and tantalum are possible
for emitter use. This paper gives major attention to the
properties of rhenium and tungsten.

1591

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

A KINETIC INVESTIGATION OF THE INTERACTION
OF ADENOSINE-5'-TRIPHOSPHATE WITH DIVALENT
METAL IONS, by G. C. Hammes and S. A. Levison.
[1964] [3]p. incl. diagrs. table, refs. (AFOSR-65-
0612) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Biochem., v. 3: 1504-1506, Oct. 1964.

Rate constants for the formation and dissociation of
Ni(II) and Co(II) complexes of ATP have been determined
utilizing the temperature-jump method; lower bounds of
the rate constants for the corresponding Mn(II) complex
have also been determined. The values of the formation
rate constant at $25°$ in $0.1M$ KNO_3 for Ni(II), Co(II), and
Mn(II) are 4.1×10^6, 9.2×10^7, and $> 10^9 M^{-1}$ sec^{-1},
respectively, while those for the dissociation rate con-
stant are 38, 2.0×10^3, and $> 10^4$ sec^{-1}. Experimental
values of the formation rate constant for these ions plus
those for Ca(II) and Mg(II) are in reasonable agreement
with calculated values based on a previously proposed
mechanism involving water dissociation from the inner
hydration shell of the metal ion as the rate-determining
step in complex formation. The implications of these
results for the understanding of metal ion specificity in
biological systems are discussed. (Contractor's
abstract)

1592

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

A SYSTEM FOR AUTOMATIC RECOGNITION OF
HANDWRITTEN WORDS, by P. Mermelstein and M.
Eyden. [1964] [10]p. incl. illus. table. (AFOSR-65-
0903) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Proc. Fall Joint Computer Conf.,
San Francisco, Calif., Oct. 27-29, 1964, p. 333-342.

Experimental results are reported for the recognition of
254 word samples under various conditions of machine
learning. The test samples were generated by 4 writers
from a vocabulary of 32 words in which each letter of
the alphabet occurred at least twice. A dictionary of the
10,000 most frequently used English words was used to
limit the recognition results to words of the language.
Experiments carried out by general purpose computer
simulation of the recognition system reveal that the sys-
tem is capable of recognizing well-formed, legible

handwritten words with a reliability that depends on the correspondence between the script of the writing sample and that of the ensemble on which the machine's representation of handwriting is based. The resulting recognition rates are found to be significantly better than those previously reported.

1593

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MINIMUM DETECTABLE CHANGE IN INTERAURAL TIME OR INTENSITY DIFFERENCE FOR BRIEF IMPULSIVE STIMULI, by J. L. Hall, II. [1964] [3]p. incl. diagrs. (AFOSR-65-1148) (DA 36-039-AMC-03200(E))   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 2411-2413, Dec. 1964.

Experimental results are presented for an investigation of the just-noticeable change in interaural time difference and interaural intensity difference as a function of over-all intensity. Three subjects were studied in a dark, sound proofed room with stimuli produced by dichotic clicks, the click to one ear leading by $\Delta\tau/2$ μ sec or more intense by $\Delta I/2$ dB. The results are presented with no attempt at physiological interpretation. (Contractor's abstract)

1594

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE OPERATION OF OPTICAL MASERS IN UNIFORM MAGNETIC FIELDS, by W. A. Runciman. [1964] [4]p. incl. diagrs. (AFOSR-65-1391) (DA 36-039-AMC-03200(E))   Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 1: 673-676, 1964.

A ruby optical maser and a helium-neon gas maser were examined in a homogeneous magnetic field. Observation of the ruby maser at various angles indicated that in all cases the Zeeman components of lowest energy are strongest. It was found possible to tune the frequency by 7 cm^{-1} using a magnetic field of 49 kilogauss and to operate the ruby maser at two frequencies separated by 5 cm^{-1}. Similar experiments with helium-neon gas masers exhibited quenching effects in the mode pattern at 3-6 kilogauss.

1595

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THEORY, PRODUCTION AND USE OF OPTICAL GRATINGS FOR HIGH-RESOLUTION SPECTROSCOPY,

by G. W. Stroke. [1964] [17]p. incl. illus. diagrs. refs. (AFOSR-65-1392) (DA 36-039-AMC-03200(E))   Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 2: 1221-1237, 1964.

Using the interferometric servo-control system, optical gratings have been ruled for spectral resolutions in the 1 million resolving power range. The simplified interferometric control system for the Jewell-Ash ruling engine is described. A short resumé is first given of the theory of the diffraction of light by gratings. The control system for the Jewell-Ash engine is then considered, and finally the application of such gratings to high-resolution spectroscopy is discussed.

1596

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

NONLINEAR EFFECTS IN SOLID STATE PLASMAS, by B. Lax, A. L. McWhorter, and J. G. Marvroides. [1964] [6]p. incl. refs. (AFOSR-65-1394) (DA 36-039-AMC-03200(E))   Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb 11-15, 1963), New York, Columbia U. Press, v. 2: 1521-1526, 1964.

Nonlinear phenomena in plasmas can be induced by intense optical fields to produce frequency doubling and mixing. It is shown theoretically that a variety of schemes are available for observing the phenomena on the surface or in the bulk materials containing electron plasmas. The bulk phenomena can be utilized to develop parametric devices which should permit the realization of amplifiers and oscillators as sources in the far infrared region of the spectrum.

1597

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE RAMAN MASER, by H. J. Zeiger and P. E. Tannenwald. [1964] [3]p. (AFOSR-65-1395) (DA 36-039-AMC-03200(E))   Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 2: 1589-1596, 1964.

In this investigation, it is shown that the emission of coherent Raman radiation is particularly favorable because it does not depend on achieving population inversion of energy levels. The Raman scattering from a crystal with ionic energy levels is calculated, and it is shown how the theory can be extended to the case of scattering from vibrational levels of a solid or liquid. The requirements for satisfying the oscillation condition are considered, based on estimates of available laser sources, laser and Raman cavity Q's, and matrix elements.

1598

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

NUCLEAR MOMENTS AND ISOTOPE AND ISOMER
SHIFTS OF NEUTRON-DEFICIENT MERCURY ISO-
TOPES 195, 195^m, 194, 193, 193^m AND 192, by W. J.
Tomlinson, III and H. H. Stroke. [1964] [20]p. incl.
diagrs. tables, refs. (AFOSR-65-1469) (DA 36-039-
AMC-0320O(E)) Unclassified

Also published in Nuclear Phys., v. 60: 614-633, 1964.

Nuclear spins I, magnetic-dipole μ and electro-quadru-
pole Q moments, and optical spectroscopic isotope and
isomer shifts (IS) were obtained for the neutron-defi-
cient mercury isotopes and isomers with mass numbers
from 192 to 195. The isotopes were produced by p, yn
reactions on Au^{197}. Approximately 0.01 μg of Hg was
transferred into the rf-excited electrodeless light
sources. A well-blazed plane diffraction grating, 25
cm wide, was used in the multiple wavelength mono-
chromator of 11 m focal length for these high-resolu-
tion optical hfs measurements. The isotope- and
isomer-shift results, which led to a hypothesis of the
cause of odd-even staggering in isotope shift are dis-
cussed. (Contractor's abstract, modified)

1599

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

DIGITAL COMMUNICATION OVER FIXED TIME-
CONTINUOUS CHANNELS WITH MEMORY—WITH
SPECIAL APPLICATION TO TELEPHONE CHANNELS,
by J. L. Holsinger. Oct. 20, 1964, 117p. incl. diagrs.
refs. (Technical rept. no. 430) (Lincoln Lab. techni-
cal rept. no. 366) (AFOSR-65-1470) (DA 36-039-
AMC-03200(E)) Unclassified

This report studies the performance of the best possi-
ble method for digital communication over fixed time-
continuous channels with memory, i.e., channels with
intersymbol interference and/or colored noise. The
channel model assumed is a linear, time-invariant fil-
ter followed by additive, colored Gaussian noise. Two
questions are considered: (1) given a set of signals,
what is the probability of error? and (2) how should
these signals be selected to minimize the probability
of error? It is shown that answers to these questions
are possible when a suitable vector space representa-
tion is used, and the basis functions required for this
representation are presented. Using this representa-
tion and the random coding technique, a bound on the
probability of error for a random ensemble of signals
is determined and the structure of the ensemble of sig-
nals yielding a minimum error bound is derived. The
inter-relation of coding and modulation in this analysis
is discussed and conclusions shown. (Contractor's
abstract, modified)

1600

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

SEQUENTIAL MEASUREMENT OF MULTIDIMEN-
SIONAL TRANSDUCERS, by J. R. Sklar. Oct. 29,
1964, 85p. incl. diagrs. tables, refs. (Technical rept.
no. 431) (Lincoln Lab. technical rept. 360) (AFOSR-
65-2272) (DA 36-039-AMC-03200(E)) Unclassified

This report analyzes a sequential algorithm suggested
by R. M. Fano and describes its application to meas-
urement problems. From the analysis, bounds to the
average number of computations needed to estimate one
parameter are obtained. A bound is also derived for the
probability of estimating at least one parameter of a set
incorrectly. This difficulty determines a limit to the
precision obtainable with the sequential method. A
series of simulation experiments was performed to test
the hypotheses and, although the theoretical and simu-
lated measurement problems were not identical, the
theoretical and experimental results agree, at least
qualitatively. (Contractor's abstract, modified)

1601

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

FREQUENCY-IMPULSE MODULATION AS A MEANS
OF ATTAINING ACCURACY IN CESIUM ATOMIC
CLOCKS, by R. S. Badessa, V. J. Bates, and C. L.
Searle. [1964] [6]p. incl. diagrs. table. (AFOSR-65-
2443) (DA 36-039-AMC-03200(E)) Unclassified

Also published in IEEE Trans. on Instr. and Meas.,
v. IM-13: 175-180, Dec. 1964.

An electronic system has been developed which corrects
for cavity-detuning errors in cesium atomic-beam fre-
quency standards. The RF signal applied to the beam
tube is square-wave phase modulated, i.e., frequency-
impulse modulated. The transient response of the beam
tube to these phase steps is used as a control signal.
When the positive and negative transients are both equal
in area and identical in shape, it will be shown that the
applied RF signal must be exactly at cesium frequency
(for the given magnetic field) and the RF cavities must
be exactly in tune. Two feedback loops are needed; one
for correcting the crystal oscillator, the other for ad-
justing the relative phase of the RF cavities. With cavi-
ty detuning error greatly reduced by this system, the
remaining source of inaccuracy is the uncertainty of the
magnetic field in the drift region of the beam tube. An
experiment is described which may permit setting a
given cesium-beam standard to a frequency that differs
by a precisely known amount from the zero-field cesi-
um-resonance frequency. (Contractor's abstract)

1602

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

ANALOG COMMUNICATION OVER RANDOMLY-TIME-

VARYING CHANNELS, by H. L. Van Trees. 1964,
25p. incl. diagrs. refs. (AFOSR-68-1808) (DA 36-
039-AMC-03200(E)) AD 451891   Unclassified

Also published in IEEE Trans. Inform. Theory, v. IT-
12: 51-63, Jan. 1968.

The problem of analog communication over a randomly-
time-varying channel is discussed.

1603

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

CONSTRUCTION OF TIME-LIMITED FUNCTIONS WITH
SPECIFIED AUTOCORRELATION FUNCTIONS, by
E. M. Hofstetter. [1964] [8]p. (DA 38-039-AMC-
03200(E)) AD 442967   Unclassified

Also published in IEEE Trans. Inform. Theory, v. IT-
10: 119-126, Apr. 1964.

A necessary and sufficient condition is derived for a
function to be the autocorrelation function of a time-
limited function of specified length. A constructive
procedure for determining all possible time-limited
functions having the same autocorrelation function as a
given time-limited function is presented. The pro-
cedure consists of passing the given time function
through one out of a collection of specially tailored all-
pass filters. The class of functions so generated may
be either finite or infinite depending on the original
time function. Specific examples of the construction
procedure are given.

1604

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

DERIVATION OF SPIN HAMILTONIANS BY TENSOR
DECOMPOSITION, by W. J. C. Grant and M. W. P.
Strandberg. [1984] [5]p. (DA 36-039-AMC-03200(E))
AD 442968   Unclassified

Also published in Jour. Phys. and Chem. Solids, v.
25: 635-639, 1964.

The spin Hamiltonian of a paramagnetic system is
derived from the decomposition of spherical tensors
having appropriate symmetry properties. Although no
explicit use of group theory is involved, the Hamil-
tonian obtained is similar to that derived from purely
group theoretical methods.

1605

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

OBSERVATIONS OF THE AEROSOL LAYER AT 20 KM
BY OPTICAL RADAR, by G. Flocco and G. Grams.
[1964] [2]p. [DA 38-039-AMC-03200(E)) AD 442972
Unclassified

Also published in Jour. Atmos. Sci., v. 21: 323-324,
May 1964.

The existence of an aerosol layer at an altitude of about
20 km has been well established by optical techniques
and by direct sampling from balloons and aircraft. Pre-
liminary results from observation of this layer with an
optical radar are reported.

1806

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

SYNTACTIC RULES USED BY CHILDREN FROM PRE-
SCHOOL THROUGH FIRST GRADE, by P. Menyuk.
[1964] [14]p. (DA 38-039-AMC-03200(E)) AD 442948
Unclassified

Also published in Child. Develop., v. 35: 533-548, 1964.

A transformational model of syntactic structures was
used to describe children's grammar from under 3 years
of age to over 7 years as a self-contained system and to
indicate developmental trends. An almost steady rise
in the percentages of children using transformations as
an increasingly older population was observed. The
youngest children excluded rules at the phase structure
and transformational levels of the grammar and alter-
nated more restricted and nonrestricted rules at all
three levels of the grammar. The addition of these ex-
cluded rules and a change in the number and nature of
the restricted forms used seem to be developmental
trends.

1607

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

SOME MEMORY ASPECTS OF FINITE AUTOMATA, by
C. L. Liu. May 31, 1963, 71p. incl. diagrs. tables.
(Technical rept. no. 411) (AFOSR-5001) (DA 36-039-
sc-78108) AD 409580   Unclassified

The most important characteristic of a finite automaton
is that it has a memory. By this we mean that the be-
havior of an automaton is dependent upon its past his-
tory. In this report several special cases are studied
in which the unique determination of the behavior of
an automaton is possible, even when a portion of its
past history is unknown.

1608

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

A DIGITAL SPECTRAL ANALYSIS TECHNIQUE AND
ITS APPLICATION TO RADIO ASTRONOMY, by S.
Weinreb. Doctoral thesis, Aug. 30, 1963, 119p. incl.
illus. diagrs. tables, refs. (Technical rept. no. 412)
(AFOSR-5483) (DA 36-039-sc-78108) AD 418413
Unclassified

An efficient, digital technique for the measurement of
the autocorrelation function and power spectrum of
Gaussian random signals is described. This report
presents an indirect method of computing the autocor-
relation function of a signal having Gaussian statistics
which greatly reduces the amount of digital processing
that is required. A review of the measurement of
power spectra through the autocorrelation function
method is given. The one-bit technique of computing
the autocorrelation function is presented; in particular,
the mean and variance of the resulting spectral esti-
mate have been investigated. These results are then
applied to the problem of the measurement of spectral
lines in radio astronomy. A complete radio-astronomy
system is described. (Contractor's abstract, modi-
fied)

1609

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

AN ANALYSIS AND SYNTHESIS PROCEDURE FOR
FEEDBACK FM SYSTEMS, by A. Wojnar. Sept. 30,
1963, 49p. incl. diagrs. tables, refs. (Technical rept.
no. 415) (AFOSR-5484) (DA 36-039-sc-78108)
Unclassified

An investigation of frequency-compressive feedback
FM systems has been made, with emphasis placed on
threshold behavior. In Part A, following a survey of
the existing noise analysis of FM systems, use is made
of a recent evaluation of the impulsive noise component
which is due to Rice. It is shown that this excess-
noise component predominates in the threshold region
of most conventional FM systems. In Part B, two pos-
sible mechanisms causing noise threshold in a feedback
FM system are examined. It is shown that the feedback
threshold results in an abrupt breakdown of system per-
formance, and therefore should not be approached too
closely. Some modified formulas for feedback FM sys-
tem performance at threshold are proposed; new bounds
on the performance of the systems with optimum feed-
back filters are derived. Experimental results with
certain feedback FM configurations are reported.
(Contractor's abstract, modified)

1610

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

INVESTIGATION OF ELECTRON-BEAM INTERAC-
TION WITH A BEAM-GENERATED PLASMA, by W. D.
Getty. Jan. 19, 1933, 110p. incl. illus. diagrs.
tables, refs. (Technical rept. no. 407) (AFOSR-
5485) (DA 36-039-sc-78108) AD 298698
Unclassified

This report is concerned with the study of the beam-
plasma interaction and the consideration of it as a pos-
sible mechanism for the heating of plasma electrons.
A strong interaction between the electron beam and a
weakly ionized gas is produced by a moderately high-
perveance electron gun operating at peak pulse voltages
up to 10 kv. After a time delay that is required for

the production of plasma by beam ionization, self-ex-
cited uhf oscillations are observed. These oscillations
are accompanied by several phenomena such as: scat-
tering of the electron beam across the axial magnetic
field by oscillatory, electric-field forces; generation
of an intense pulse of visible light which occurs simul-
taneously with the beam scattering; and excitation of
electrons to energies above 100 ev. An approximate
small-signal theory of wave propagation in a cylindrical
beam-plasma system is applied in the interpretation of
certain properties of the plasma oscillations. It is con-
cluded that, in a beam-generated plasma system, the
oscillations start at a frequency that is determined by
the magnetic field, and they become sufficiently intense
to impart a significant oscillatory energy to the plasma
electrons. (Contractor's abstract, modified)

1611

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

CODING AND DECODING FOR TIME-DISCRETE AM-
PLITUDE-CONTINUOUS MEMORYLESS CHANNELS, by
J. Ziv. Jan. 31, 1963, 101p. incl. diagrs. tables,
refs. (Technical rept. no. 399) (AFOSR-5486) (DA 36-
039-sc-78108) AD 299016 Unclassified

This report can be summarized under 3 main headings:
(1) Signal space structure—A scheme for constructing
a discrete signal space, for which sequential encoding-
decoding methods are possible for the general continu-
ous memoryless channel, is described. The effects of
these signal-space constraints on the average probabili-
ty of error, for different signal-power constraints, are
also discussed. (2) Decoding schemes—The applica-
tion of sequential decoding to the continuous asymmet-
ric channel is discussed. A new decoding scheme for
convolutional codes, called successive decoding, is
introduced. The corresponding probabilities of error
of the 2 decoding schemes are also discussed. and (3)
Quantization at the receiver—Its effects on probability
of error and receiver complexity are considered.
(Contractor's abstract, modified)

1612

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

THRESHOLD DECODING, by J. L. Massey. Apr. 5,
1963, 123p. incl. diagrs. tables, refs. (Technical
rept. no. 410) (AFOSR-5487) (DA 36-039-sc-78108)
AD 407946 Unclassified

Two procedures for decoding linear systematic codes,
majority decoding and a posteriori probability decoding,
are formulated. The essential feature of both methods
is a linear transformation of the parity-check equations
of the code into "orthogonal parity checks." The de-
coding decisions are then made on the basis of the val-
ues assumed by these orthogonal parity checks. For
binary codes, the principal component required in the
circuitry for instrumenting these decoding rules is an
ordinary threshold logical element. For this reason,
these decoding rules are referred to as forms of

"threshold decoding." It is shown that threshold decoding can be applied effectively to convolutional codes up to approximately 100 transmitted bits in length over an interesting range of rates. Very simple decoding circuits are presented for such codes. It is also shown that threshold decoding is applicable to certain low-rate block codes, and that a generalization of the method is applicable to several other classes of block codes. (Contractor's abstract, modified)

1613

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

[GENERAL NOTIONS CONCERNING THE MACRO-SCOPIC THEORY OF WAVES IN PLASMAS] Notions generales sur la theorie macroscopique des ondes dans les plasmas, by W. P. Allis and J. L. Delcroix. [1963] [38]p. incl. diagrs. tables, refs. (AFOSR-5501) (DA 36-039-sc-78108) AD 447416   Unclassified

The propagation of monochromatic plane waves in an indefinite plasma is treated in the hydrodynamic theory of two fluids. Plasmas with isotropic pressure and waves obeying exact adiabaticity are considered.

1614

[Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge]

MEASUREMENTS OF THE SUN, MOON, VENUS, AND TAU A AT 1.18 CM WAVELENGTH, by D. H. Staelin, A. H. Barrett, and B. R. Kusse. [1963] [1]p. (AFOSR-J977) (DA 36-039-sc-78108)   Unclassified

Also published in Astronom. Jour., v. 88: No. 1310, June 1963.

During December 1962 observations were made of the sun, moon, Venus, and Tau A at 1.18-cm wavelength (f = 25.5 Gc/sec). A 8.0 min beamwidth was obtained using the 28-ft-diameter paraboloid reflector at Lincoln Laboratory, MIT. The radiometer was a Dicke-type superheterodyne with a bandwidth of 8 Mc/sec and a sensitivity of 2.5°K with a 5-sec integration time. Data from these observations are given.

1615

Massachusetts Inst. of Tech. Research Lab. of Electronics. Cambridge.

A CIRCULARLY POLARIZED MASER OSCILLATOR, by T. Ogawa. [1963] [6]p. incl. illus. diagrs. refs. (AFOSR-J990) (DA 36-039-sc-78108)   Unclassified

Also published in Jour. Appl. Phys., v. 34: 484-489, Mar. 1963.

The frequency stability of a circularly polarized solid-state paramagnetic maser oscillator has been observed with the objective of obtaining the information needed to construct a frequency standard with a broad micro-

wave spectral line. The beat frequency between two such masers by using ruby can be made almost free from the variation of the static magnetic field and of the angle between the crystalline axes and the static magnetic field. The stability of the 1.5-mc beat frequency is approximately 10^{-6} for short time intervals, and is approximately 10^{-5} for long time intervals. The effect of reflections from the load on frequency is considerably reduced by the unidirectional structure used here, as compared with that to be expected with a reflection type of maser. (Contractor's abstract, modified)

1616

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERTURBATION OF VOWEL ARTICULATIONS BY CONSONANTAL CONTEXT: AN ACOUSTICAL STUDY, by K. N. Stevens and A. S. House. [1963] [18]p. incl. diagrs. tables, refs. (AFOSR-J1000) (DA 38-039-sc-78108)   Unclassified

Also published in Jour. Speech and Hearing Research, v. 6: 111-128, June 1963.

Measurements of the formant frequencies and band-widths of 8 common vowels of American English are described. The speech materials were provided by 3 adult male talkers and the measurements were performed using a spectrum-matching procedure implemented on a general-purpose digital computer. The differences between the present data and measurements in the literature, and the systematic differences in formant data from one talker to another are discussed and explicated in terms of an acoustical theory of speech production and certain postulated dynamic properties of the articulatory mechanism.

1617

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ODOR SPECIFICITIES OF THE FROG'S OLFACTORY RECEPTORS, by R. C. Gesteland, J. Y. Lettvin and others. [1963] [16]p. incl. diagrs. table. (AFOSR-J1007) (DA 38-039-sc-78108)   Unclassified

Also published in Proc. First Internat'l. Symposium on Olfaction and Taste; Oxford, Pergamon Press, 1963, p. 19-34.

This report may be summarized as follows: (1) A new recording technique that allows the action potentials of single primary olfactory receptors in the frog to be recorded extracellularly is described; (2) The general response patterns of the olfactory receptors are described and correlated with the observations on the slow potentials of the mucosa; (3) Some of the odor-specific properties of the receptors are described; and (4) Possible receptor mechanisms are discussed in the light of the new data on odor-specific responses.

1618

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

SIMPLIFIED ANALYSIS OF THE RIJKE PHENOMENON,
by G. C. Maling, Jr. [1963] [2]p. incl. diagr.
(AFOSR-J1120) (DA 38-039-sc-78108) AD 417807
Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35:
1058-1060, July 1963.

The wave equation including source terms that arise
because of introduction of heat into a medium has been
used as the starting point for a small-signal analysis
of the Rijke phenomenon. The dependence of the on-
set of oscillation on mean flow velocity through the
tube has been found for 3 different values of heater
power. The results of the analysis compare favorably
with experimental results when the cutoff occurs at
high flow velocities. At lower flow velocities, the
analysis is not satisfactory because of an instability in
the mean flow. (Contractor's abstract)

1619

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

HYPERFINE STRUCTURE, ISOTOPE, AND ISOMER
SHIFTS IN Hg^{193m}, Hg^{194}, Hg^{195m}, AND Hg^{195}—
COMMENTS ON THE PAPER F KLEIMAN AND
DAVIS, by W. J. Tomlinson, III and H. H. Stroke.
[1963] [3]p. incl. illus. diagr. tables. (AFOSR-J1121)
(DA 36-039-sc-78108) AD 415792   Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 828-
830, July 1963.

An analysis has been made of the discrepancies be-
tween the hfs and isotope shift results for Hg^{194},
Hg^{195}, and Hg^{195m} of Kleiman and Davis and the data
obtained particularly in view of the importance of
these results for interpretation of the odd-even stag-
gering effect in isotope shift. The hfs results have
been confirmed by the more precise level-crossing
experiments. Errors in the work of Kleiman and
Davis have been attributed, in part, to the presence of
Hg^{197} and Hg^{197m} in their sources. Experimental
results are shown for the Hg^{194} isotope shift. It was
found that $Hg^{194}- Hg^{198}$ isotope shift = 0.146 ± 0.010
cm^{-1}, and a preliminary value $Hg^{193m}- Hg^{195m}$
shift = 0.150 cm^{-1}. These results lend further sup-
port to the hypothesis on the causes of odd-even stag-
gering in isotope shift. (Contractor's abstract,
modified)

1620

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

STARK EFFECT AND HYPERFINE STRUCTURE OF

HYDROGEN FLUORIDE, by R. Weiss. [1963] [7]p.
incl. illus. diagrs. tables, refs. (AFOSR-J1122)
(DA 36-039-sc-78108) AD 415790   Unclassified

Also published in Phys. Rev., v. 131: 659-665, July
15, 1963.

The nuclear hyperfine structure constants and the
electric dipole moment of hydrogen fluoride, H^1F^{19},
in the ground-vibrat... and first excited rotation state
have been measure in a molecular beam electric
resonance experiment. A digitally computed solution of
the Stark effect with magnetic hyperfine structure was
necessary to interpret the data. The theory and experi-
ment are in good agreement over the range of electric-
field strengths used in the experiment. The hfs con-
stants are in excellent agreement with the averaged ab-
solute values of these constants as measured in a mo-
lecular beam magnetic resonance experiment. The
agreement has significance because of discrepancies
between the results from the two resonance methods,
for some other molecules, in previous experiments.
(Contractor's abstract, modified)

1621

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

A HEURISTIC DISCUSSION OF PROBABILISTIC DE-
CODING, by R. M. Fano. [1963] [11]p. incl. diagrs.
refs. (AFOSR-J1124) (DA 36-039-sc-78108)
Unclassified

Also published in IEEE Trans. Inform. Theory, v. IT-
9: 64-74, Apr. 1963.

The purpose of this paper is to present a heuristic dis-
cussion of the probabilistic decoding of digital mes-
sages after transmission through a randomly disturbed
channel. The adjective "probabilistic" is used to dis-
tinguish the decoding procedures discussed here from
algebraic procedures based on special structural prop-
erties of the set of code words employed for transmis-
sion. In order to discuss probabilistic decoding in its
proper frame of reference, the more general problem
of transmitting digital information through randomly
disturbed channels is outlined and some of the key con-
cepts and results pertaining to it are briefly reviewed.

1622

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

ON THE EFFECT OF ATMOSPHERIC TURBULENCE
ON SOUND PROPAGATED OVER GROUND, by U.
Ingard and G. C. Maling, Jr. [1963] [3]p. incl. diagrs.
refs. (AFOSR-J1393) (DA 36-039-sc-78108)
Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35:
1056-1058, July 1963.

The sound field above a plane boundary has been calcu-
lated by assuming that both the direct and reflected

waves fluctuate in amplitude and phase. The pressure field is described in terms of a time-dependent mean-square pressure $(\overline{p^2})$ whose statistical properties are studied. The mean and variance of $(\overline{p^2})$ have been calculated by assuming that the turbulent fluctuations are normally distributed. The results are compared with some experimental data obtained outdoors over a large rigid boundary. Most of the experimental data have been found to be in good agreement with the calculations. (Contractor's abstract)

1623

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

$^3S_1$ HYPERFINE-STRUCTURE SEPARATIONS AND ISOTOPE SHIFTS OF RADIOACTIVE Cd^{107}, Cd^{109}, AND OF STABLE Cd ISOTOPES, by R. J. Hull and H. H. Stroke. [1963] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-J1545) (DA 36-039-sc-78108)
Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 1147-1152, Oct. 1963.

High-resolution spectra of radioactive Cd^{107} and of Cd^{111} and Cd^{113} were obtained in the wavelengths $\lambda = 3261, 4678, 4300,$ and 5085 A. The $Cd^{109}-Cd^{113}$ isotope shift was found in the 3261-A resonance line, 0.033 ± 0.005 cm^{-1}, with the sign of the volume-dependent isotope shift and hfs separation in the 5s6s $^3S_1$ state, $\Delta\nu(Cd^{113}) = -0.407 \pm 0.005$ cm^{-1}. The three 5s6s to 5s5p ^3P lines display isotope shifts that are smaller than the precision of the experiment. A factors of Cd^{107}, Cd^{109}, and Cd^{111} are obtained from the spectroscopic and the published resonance and level-crossing data. The isotope shift is studied in combination with previous results in the light of possible nuclear polarizability effects. (Contractor's abstract, modified)

1624

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STAGES IN THE EDUCATION OF A PHYSICIST: AN ATTEMPTED SOLUTION OF A PEDAGOGICAL PROBLEM, by D. H. Douglass, Jr. and M. W. P. Strandberg. [1963] [6]p. incl. table. (AFOSR-J1546) (DA 36-039-sc-78108)
Unclassified

Also published in Amer. Jour. Phys., v. 31: 707-712, Sept. 1963.

The stages in the development of a professional physicist are considered. One of the weak points of this process, the transition from the student stage to research apprenticeship, is considered in some detail. A teaching experiment that has been performed at MIT and was designed to bridge this gap is discussed. The

results of this experiment lead to the proposal of this procedure as a partial solution to this particular problem. (Contractor's abstract)

1625

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CENTRAL FACTORS IN AUDITORY FREQUENCY SELECTIVITY, by J. A. Swets. [1963] [12]p. incl. table, refs. (AFOSR-64-0309) (DA 36-039-sc-78108)
Unclassified

Also published in Psychol. Bull., v. 60: 429-440, Sept. 1963.

Evidence for involvement of cognitive factors makes it seem clear that the number, the frequency locations, and the widths of the critical bands which are operative in a given auditory task reflect to a substantial extent the strategy of listening that is adopted by O for that particular task. Central modulation of sensory information is extensive enough to make unlikely the discovery, through psychophysical methods, of a unitary peripheral process that remains stable despite changes in O's task, his information, and his aims. The value of a psychophysical approach to peripheral sensory mechanisms depends upon the ability to specify, and then on the ability to isolate, the central contribution to O's response. (Contractor's abstract)

1626

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MONOGENIC NORMAL SYSTEMS ARE UNIVERSAL, by M. A. Arbib. [1963] [6]p. incl. diagrs. (AFOSR-64-0310) (DA 36-039-sc-78108)
Unclassified

Also published in Jour. Australian Math. Soc., v. 3: 301-306, 1963.

In 1943, Post conjectured that "monogenic normal systems are universal", and in 1961 Minsky proved a stronger result "tag' systems are universal" which implied the proof of Post's conjecture. The author had independently obtained a simple direct proof of Post's conjecture. The purpose of this note, then, is to present an exposition of Post's conjecture, and to show the full simplicity of its direct verification. (Contractor's abstract)

1627

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE MECHANISM OF ENZYMATIC TRANSAMINATION, by G. G. Hammes and P. Fasella. [1963] [11]p. incl. diagrs. table, refs. (AFOSR-64-0315) (DA 36-039-sc-78108)
Unclassified

Also published in Proc. of Symposium on Chem. and Biol. Aspects of Pyridoxal Catalysis; Rome (Italy) (1962). Oxford, Pergamon Press, 1963, p. 185-195.

The mechanism of enzymatic transamination has been investigated using purified glutamic-aspartic transaminase as a particular example. Both the kinetic and equilibrium properties of the enzyme-substrate systems were investigated at high enzyme concentrations ($> 10^{-3}$M). The kinetic studies were carried out over a time range from 5 μsec to 1 sec. At pH 8.0, the minimal mechanism consistent with all of the data as is as follows: $E_L + As = X_1 = X_2 = E_M + Oa$, $E_M + Kg = Y_2 = Y_1 = E_L + Gm$. A study of the interaction of hydroxylamine with enzyme revealed that the equilibrium constant for Schiff base formation is more favorable for the combination of hydroxylamine with the enzyme at low pH's, although the enzyme is catalytically inactive at these same pH's. A quantitative study of the interaction of keto acids with the pyridoxal form of the enzyme indicated that the rate constant characterizing the formation of $E_L KA$ and $E_L KAH^+$ complexes is essentially diffusion controlled ($> 5 \times 10^8$ M^{-1}sec^{-1}). Possible roles of the protein molecule in the catalytic process are also discussed. (Contractor's abstract, modified)

1628

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DESIGN AND CONSTRUCTION OF HIGH MAGNETIC FIELD TRAVELING WAVE LINES, by L. M. Lidsky and D. J. Rose. [1963] [5]p. incl. illus. diagrs. tables. (AFOSR-64-0323) (DA 36-039-sc-78108)
Unclassified

Also published in Rev. Sci. Instr., v. 34: 1223-1227, Nov. 1963.

A pulsed, capacitively loaded helical line capable of generating 5000-G pulses is described. The line velocity is 15 cm/μsec. Titanate ceramics are used as the dielectric elements. The analysis and design take into account the often overlooked effect of inductive coupling between line elements. A formalism suitable for numerical computation of complicated systems is illustrated. The design can be extended to give a variable velocity 9-kG line. (Contractor's abstract)

1629

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

REALIZABILITY OF INDUCTIVE LOGIC, by M. C. Goodall. [1963] [6]p. incl. diagrs. refs. (AFOSR-64-0327) (DA 36-039-sc-78108)
Unclassified

Also published in IEEE Trans. Military Electron., v. MIL-7: 168-173, Apr.-July 1963.

The basic model is a two-way communication system

in which observer O transmits axioms A, interprets received message S* by rules R of a Post normal logic. O's strategy is to generate (applying R to A) derivations S that minimize d(S, S*), subject among other things, to R being Turing universal. This implies that (A, R:S*) are analogs of complementary observables and interaction potential in quantum mechanics. The model shows, in contrast to the quantum analog, the characteristic openness of induction: namely, S* is not an analytic potential determining probability Pr(R) uniquely, so that restrictions, such as those given, are necessary on the superabundance of R, which, if not arbitrary, must depend on realizability of higher level generalizations. Thus we have here a first stage in a quantitative transformation theory of language. (Contractor's abstract, modified)

1630

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

kTH-ORDER FINITE AUTOMATON, by C. L. Liu. [1963] [6]p. incl. diagrs. tables. (AFOSR-64-0332) (DA 36-039-sc-78108)
Unclassified

Also published in IEEE Trans. Electron. Comput., v. EC-12: 470-475, Oct. 1963.

A kth-order finite automaton is an automaton whose next state is a function of its most recent k states as well as its present input. A procedure to test whether a given ordinary automaton is equivalent to some kth-order automaton is suggested. (Contractor's abstract)

1631

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DETECTION OF SCATTERING LAYERS IN THE UPPER ATMOSPHERE 960-140 km) BY OPTICAL RADAR, by G. Flocco and L. D. Smullin. [1963] [2]p. incl. diagrs. table. (AFOSR-64-0333) (DA 36-039-sc-78108)
Unclassified

Also published in Nature, v. 199: 1275-1276, Sept. 28, 1963.

This communication reports observations made by us of optical echoes from atmospheric constituents (presumably dust) at heights of 60-140 km. They were detected with an optical radar. The techniques utilized are a development of those previously reported. The results obtained from these observations are given.

1632

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE INTERACTION OF GLUTAMIC-ASPARTATE TRANSAMINASE WITH PSEUDO SUBSTRATES, by

G. G. Hammes and P. Fasella. [1963] [4]p. incl. diagrs. tables, refs. (AFOSR-64-0337) (DA 36-039-sc-78108) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 3929-3932, Dec. 20, 1963.

Equilibrium and kinetic studies have been made of the interaction of the aldehydic form of glutamic-aspartate transaminase with hydrogen ion, hydroxylamine, keto-glutarate, and oxalacetate. Spectrophotometric methods and the temperature jump technique were primarily employed. A pK of 6.25 was measured for the transformation of the enzyme between a yellow and colorless form. Hydroxylamine forms a complex, presumably an oxime, with both forms of the enzyme, the binding constant for the interaction with the protonated enzyme being much larger. The rate constants for this process are similar to those of the enzyme-substrate reactions. The keto acids, ketoglutarate and oxalacetate, also form complexes with both forms of the enzyme. Again the protonated enzyme interacts much more strongly with the pseudo substrates. The formation of these keto acid complexes is essentially diffusion controlled. The relevance of these findings to the enzymatic mechanism is discussed. (Contractor's abstract, modified)

1633

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELASTIC CONSTANTS OF AMMONIUM CHLORIDE NEAR THE LAMBDA POINT, by C. W. Garland and J. S. Jones. [1963] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0338) (DA 36-039-sc-78108) Unclassified

Also published in Chem. Phys., v. 39: 2874-2880, Dec. 1, 1963.

The adiabatic elastic constants of single-crystal ammonium chloride have been measured as functions of sound frequency from 5 to 55 mc/sec, and as functions of temperature from ~150° to 300°K by an ultrasonic pulse technique. The values of the constants at 300°K are $c_{11} = 3.70$, $c_{44} = 0.86$, $(c_{11}-c_{12})/2 = 1.41$ in units of 10^{11} dyn/cm^2. Special emphasis was given to the region around 243°K, the critical temperature for the order-disorder transition. The results are discussed in terms of the phenomenological thermodynamic theory of Pippard. (Contractor's abstract)

1634

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

KINETIC THEORY OF PLASMA AND THE ELECTRO-MAGNETIC FIELD, by T. H. Dupree. [1963] [16]p. incl. refs. (AFOSR-64-0339) (DA 36-039-sc-78108) Unclassified

Also published in Phys. Fluids, v. 6: 1714-1729, Dec. 1963.

An exact kinetic equation for plasma and the electromagnetic field is derived. This equation describes the fluctuations of the fields and particle distributions. The solution is obtained by expanding in a parameter which characterizes the amplitude of these fluctuations. A systematic procedure is given for generating the solution to arbitrary order in the expansion. Some typical applications of the theory are presented. These include calculations of a collision integral, incoherent scattering, and bremsstrahlung emission and absorption. (Contractor's abstract)

1635

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RADIO OBSERVATIONS OF OH IN THE INTERSTELLAR MEDIUM, by S. Weinreb, A. H. Barrett and others. [1963] [3]p. incl. diagr. tables, refs. (AFOSR-64-0340) (DA 36-039-sc-78108) Unclassified

Also published in Nature, v. 200: 829-831, Nov. 30, 1963.

This article reports the detection of 18-cm absorption lines of the hydroxyl (OH) radical in the radio absorption spectrum of Cassiopela A, thereby providing positive evidence for the existence of OH in the interstellar medium. The evidence may be summarized as follows: (1) Lines at both 1,667 mc/sec and 1,665 mc/sec have been detected with frequencies and intensity ratios that are in good agreement with the expected values; (2) The OH absorption spectra at both frequencies show general agreement with the H absorption spectra; (3) The absorption lines disappear when the antenna is positioned off Cassiopela A by one degree in both azimuth and elevation; and (4) The lines shifted 20 kc/sec between October 17 and October 29; this is the shift expected from the orbital velocity of the Earth during this time-interval.

1636

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

BINAURAL INTERACTION IN THE ACCESSORY SUPERIOR OLIVARY NUCLEUS OF THE CAT - AN ELECTROPHYSIOLOGICAL STUDY OF SINGLE NEURONS, by J. L. Hall. Doctoral thesis, Jan. 22, 1964, 88p. (Technical rept. no. 416) (DA 36-039-sc-78108) AD 430953 Unclassified

In a effort to understand the neural encoding of binaurally presented stimuli, clicks were presented through earphones to the 2 ears of Dial-anesthetized cats. The electrical response activity of single nerve cells in the accessory nucleus of the superior olive was studied. Stimulus parameters investigated include interaural time difference, interaural intensity difference, and average intensity. Attention was focused on cells that were excited by stimulation of the contralateral ear and inhibited by stimulation of the ipsilateral ear.

1637

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

CODING FOR PRACTICAL COMMUNICATIONS SYS-
TEMS, by P. Elias. [1963] [23]p. (DA 36-039-sc-
78108) AD 444273   Unclassified

Also published in Radio Waves and Circuits, New York,
Elsevier Publishing Co., 1963, p. 125-147.

A discussion of the application of error-correcting
codes to practical communications systems leads to the
following conclusions: (1) Coding and decoding equip-
ment to implement known schemes is feasible, and (2)
Decoding error probability is independent of the statis-
tical characteristics of the source of data, which need
not be known. For a scatter link with time-varying
path loss, 3 channels are considered. Their average
capacities can be measured and the measurement need
not be precise; known codes and decoding procedures can
be used in all 3 channels, and a code of given rate be-
comes more reliable and easier to decode as channel ca-
pacity increases. Coding may be used in these time-
varying channels to give the same reliability as in chan-
nels with independent errors, with substantially the same
equipment complexity, at a moderate cost in additional
delay.

1638

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

DETERMINATION OF THE FINAL STATE OF AN
AUTOMATON WHOSE INITIAL STATE IS UNKNOWN,
by C. L. Liu. [1963] [4]p. (DA 36-039-sc-78108)
AD 439713   Unclassified

Also published in IEEE Trans. Electron. Comput.,
v. EC-12: Dec. 1963.

Methods are developed to illustrate whether or not it
is possible to determine the final state of a finite auto-
maton when (1) the initial state of the automaton is un-
known and the input sequence and its corresponding
output sequence are given and (2) both the initial state
and the input sequence are unknown and only the output
sequence is given.

1639

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

NOTE ON BINAURAL MASKING-LEVEL DIFFERENCES
AT HIGH FREQUENCIES, by N. I. Durlach. [1964]
[6]p. (DA 36-039-sc-78108) AD 440490
                    Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36:
576-581, Mar. 1964.

A quantitative black-out model is developed for use in
interpreting certain data on binaural masking-level
differences at high frequencies. The basic idea

of this model is that these differences are the result
of variations in the extent to which the envelopes of the
signals presented to the two ears of the listener are
unequal.

1640

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

A PERTURBATION SOLUTION OF THE EQUATION OF
MOTION FOR THE DENSITY MATRIX, by H. C.
Praddaude. [1962] [13]p. (DA 36-039-sc-78108)
                    Unclassified

Published in Ann. Phys., v. 22: 210-222, May 1963.

A solution of the Laplace transform of the equation of
motion for the density matrix is obtained in terms of a
resolventlike operator. A suitable expansion of the re-
solvent in terms of irreducible matrix elements is ob-
tained and as an application of the formalism, the emis-
sion of radiation from a 2-level system is treated in the
lowest order of present perturbation theory.

1641

Massachusetts Inst. of Tech. [Research Lab. of
Electronics] Cambridge.

SIMULTANEOUS STUDIES OF FIRING PATTERNS IN
SEVERAL NEURONS, by G. L. Gerstein and W. A.
Clark. [1964] [3]p. (DA 36-039-sc-78108)
AD 440492   Unclassified

Also published in Science, v. 143: 1325-1327, Mar. 20,
1964.

A tungsten microelectrode with several small holes
burnt in the vinyl insulation enables the action poten-
tials from several adjacent neurons to be observed
simultaneously. A digital computer is used to separate
the contributions of each neuron by examining and clas-
sifying the waveforms of the action potentials. These
methods allow studies to be made of interactions be-
tween neurons that lie close together.

1642

Massachusetts Inst. of Tech. Research Lab. of
Electronics, Cambridge.

WAVES IN ANISOTROPIC PLASMAS, by W. P. Allis.
S. J. Buchsbaum, and A. Bers. 1963, 280p. incl.
diagrs. tables, refs. (DA 36-039-sc-78108)
AD 400916   Unclassified

This report discusses Free waves: General properties
of waves in anisotropic media, Particle displacements
in the electric field, Phase velocity surfaces, Polariza-
tion, Transport theory, and Boltzmann theory. and (2)
Energy-power theorems and guided waves: Conserva-
tion principles for temperature plasmas, Field analysis
of plasma waveguides, and Boundary-value problems

and approximate techniques. Also discussed are Evaluation of integrals for the conductivity, and Expansions of the dielectric tensor for low temperatures.

1643

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RESEARCH ON PARAMAGNETIC RESONANCES, by M. W. P. Strandberg and R. L. Kyhl. Final rept. Jan. 15, 1963, 27p. (DA 36-039-sc-67376) AD 401469   Unclassified

Research in the field of paramagnetism and metal physics is reviewed. Topics include paramagnetic spin-lattice relaxation, paramagnetic resonance line shapes, masers, lasers, ferroelectric crystals, thin-film superconductivity, microwave surface impedance of superconductors, and studies using coherent phonons.

1644

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STUDIES OF SENSORY PATHWAYS, by P. D. Wall. Final scientific rept. Nov. 1, 1963-Oct. 31, 1964. Nov. 30, 1964, 3p. (AFOSR-65-0153) (AF AFOSR-64-591) AD 610826   Unclassified

Summaries of two phases of the research underway are presented. In the first, problems are discussed relative to devising a computer program which will satisfy the essential requirement of a biological model. In the second, a behavioral, anatomical, and electrophysiological investigation to determine the structural and functional properties of the dorsolateral spinal cutaneous afferent system in the cat is described.

1645

Massachusetts Mental Health Center, Boston.

NORMS ON THE HARVARD GROUP SCALE OF HYPNOTIC SUSCEPTIBILITY FORM A, by R. E. Shor and E. C. Orne. [1963] [9]p. (AFOSR-J329) (AF 49(636)-726) AD 408012   Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 11: 39-47, 1963.

Norms are presented on an adaptation for group administration with self-report scoring of Weitzenhoffer and Hilgard's Stanford Hypnotic Susceptibility Scale, Form A. Comparisons are made between a sample of 132 undergraduates given the new-group administered version and four reference samples including the original Stanford U normative group. Findings indicate that the group-administered version yields norms congruent with the individually-administered original. Diagnostic evaluations of hypnotic depth after one or more additional hypnotic training sessions tentatively indicate that the adapted scale is an effective predictor of subsequent hypnotic depth.

1646

Massachusetts Mental Health Center, Boston.

THE CONTRIBUTION OF NONDEPRIVATION FACTORS IN THE PRODUCTION OF SENSORY DEPRIVATION EFFECTS: THE PSYCHOLOGY OF THE PANIC BUTTON, by M. T. Orne and D. E. Scheibe. [1964] [10]p. (AFOSR-64-0826) (AF 49(636)726) AD 436384   Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 68: 3-12, 1964.

From the premise that both social cue factors, or demand characteristics, and sensory deprivation operations combine in producing commonly observed effects of sensory deprivation, an experiment is reported which tests the hypothesis that sensory deprivation effects can be produced by manipulating demand characteristics while holding the effect of the physical environment constant.

1647

Massachusetts Mental Health Center, Boston.

AN EXPERIMENTAL COMPARISON OF HYPNOTIC DEPTH MEASURED BY SELF-RATINGS AND BY AN OBJECTIVE SCALE, by D. N. O'Connell. [1964] [13]p. (AFOSR-64-0631) (AF AFOSR-63-86) AD 436366   Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 12: 34-46, 1964.

The behavioral items of an individually-administered test of hypnotic susceptibility were scored by the subjects themselves and by observers. Susceptibility scores derived from these self-ratings and observer-ratings were in excellent agreement and did not differ significantly in distribution. Marked item scoring biases were found as a function of hypnotizability: poor hypnotic subjects tending to underevaluate their performance and good ones to overevaluate it. Moderate correlations were found between magnitude estimates made by subjects of their subjective hypnotic depth and both observer-ratings and self-rating susceptibility scores.

1646

[Massachusetts Mental Health Center, Boston]

PSYCHOLOGICAL CORRELATES OF PLATEAU HYPNOTIZABILITY IN A SPECIAL VOLUNTEER SAMPLE, by R. E. Shor, M. T. Orne, and D. N. O'Connell. Sept. 1964, 116p. (AFOSR-64-2499) (AF AFOSR-63-66) AD 609713   Unclassified

A number of specific hypotheses about correlates of hypnotizability were tested. Findings confirmed the hypotheses that hypnotizability could be predicted from general propensity for unusual subjective hypnotic-like experiences, from attitudes and motivational factors specifically relating to hypnosis, and from postural

sway, heat illusion, and vividness of mental imagery. In addition, with few exceptions the hypothesis was supported that there would be only negligible relationships between hypnotizability and measures of personality.

1649

[Massachusetts Mental Health Center, Boston]

[INVESTIGATION OF THE NATURE AND USES OF HYNOSIS AS A CONTROL TECHNIQUE]. Final rept. Dec. 1964 [8]p. incl. refs. (AFOSR-64-2519) (AF AFOSR-63-88)   Unclassified

The studies conducted under this contract were concerned with the nature of the hypnotic phenomenon. They included investigations of psychophysiological responses during hypnosis, the development of techniques to facilitate such an approach, the investigation of changes which can be brought about by hypnosis with special emphasis on social control and antisocial behavior and, finally, a major effort to study the psychological and psychophysiological correlates of hypnotizability. In the process of the latter studies the Harvard Group Scale of Hypnotic Susceptibility was developed.

1650

Massachusetts Mental Health Center, Boston.

A NOTE ON SHOCK TOLERANCES OF REAL AND SIMULATING HYPNOTIC SUBJECTS, by R. E. Shor. [1964] [5]p. (AFOSR-65-0073) (AF AFOSR-63-88) AD 455660   Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 12: 258-262, 1964.

Prior to the induction of hypnosis, subjects who later in an experiment were actually to be hypnotized selected lower criterion electric shock levels than did subjects who later were only to simulate hypnosis. This is the first quantified objective difference found to date between the behavior of reals and simulators.

1651

Massachusetts Mental Health Center, Boston.

A NOTE ON THE OCCURRENCE OF HYPNOSIS WITHOUT CONSCIOUS INTENT, by M. T. Orne. [1964] [6]p. (AFOSR-65-0074) (AF AFOSR-63-88) AD 455677   Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 12: 75-80, 1964.

Anecdotal data reporting the occurrence of hypnosis in the absence of the hypnotist and without apparent conscious intent on the part of the subject are discussed. It is felt that this phenomenon has considerable implications for an understanding of the hypnotic process. An authenticated autobiographical report of such an event is introduced.

1652

Massachusetts U. [Dept. of Psychology] Amherst.

NOISE AND HUMAN PERFORMANCE, A PSYCHO-PHYSIOLOGICAL APPROACH, by W. H. Teichner, E. Arees, and R. Reilly. [1963] [15]p. incl. diagrs. refs. (AFOSR-J528) (AF AFOSR-62-202) AD 407867   Unclassified

Also published in Ergonomics, v. 6: 83-97, Jan. 1963.

A theoretical approach is developed for the study of the effects of noise on human performance which takes into account the psychological factors of distraction and habituation and the physiological factors of auditory adaptation and bodily arousal. Two experiments designed to test theoretical predictions suggested that the approach is reasonable. Distraction studied in terms of changes in ambient noise levels was found to be a function of the amount of change. When adaptation of the ear is controlled by use of on-off sound sequences, ignoring distraction, performance is directly related to the on-off ratio early in exposure and inversely related to the ratio later in exposure. At all sound ratios performance in noise is better than in quiet. When distraction is taken into account, these results are influenced by the differences in rate and amount of adaptation of loudness and rate of habituation to distraction so that at any given time performance may seem to be decreased, increased or unaffected. (Contractor's abstract)

1653

Massachusetts U. [Dept. of Psychology] Amherst.

THE EFFECTS OF ENVIRONMENTAL TEMPERATURE AND ALERTING STIMULI ON PROLONGED SEARCH, by E. A. Arees. June 1963, 29p. (Rept. no. TN-2) (AFOSR-5349) (AF AFOSR-63-404) AD 466160   Unclassified

The purpose of this investigation was to evaluate the effects of air temperature and alerting signals on target detection in a prolonged search task and to evaluate the results in terms of their relations to the physiological thermal gradient. Twenty-four subjects were exposed to air temperatures of 55°, 75° and 105°F at 40% relative humidity under various presentation patterns of a 1-min alerting signal. The results suggest the following conclusions for the conditions involved: (1) Target detection correlates with the physiological thermal gradient for individual subjects. Best individual performance occurs at different air temperatures for different individuals. (2) Target detection appears to be independent of the physiological thermal gradient and of air temperature when averaged over all subjects (3) Alerting stimuli of the sort used have no effect on either target detection or the thermal gradient.

1654

Materials Research Corp., Orangeburg, N. Y.

A STUDY OF SCIENTIFIC RESEARCH MATERIALS,

by G. Murray, A. Johnson and others. Quarterly technical rept. no. 3, Oct. 1, 1963--Jan. 1, 1964. Feb. 12, 1964, 80p. (Rept. no. 452) (AF 49(638)1241) AD 432874   Unclassified

Effort was directed toward (1) a further study of the parameters pertinent to the electron beam zone refinement or refractory metals, (2) a feasibility determination of a plasma heat source for zone refinement, (3) preparation of intermetallic compounds, and (4) initiation of a program in the flux methods of a nonmetallic crystal growth.

1655

Matrix Corp., Arlington, Va.

THE WIT AND HIS GROUP, by J. D. Goodchilds and E. E. Smith. [1964] [9]p. incl. tables, refs. (AFOSR-1983) (AF 49(638)1000) AD 438550   Unclassified

Also published in Human Relations, v. 17: 23-31, 1964.

Two studies of six-person groups of adult male subjects were conducted to examine some personality correlates and possible effects upon the group of naturally occurring witty behavior. The major findings were as follows: (1) All wits were high participants and conformed less to group opinions; (2) Deliberate wits expressed a positive self-image on a variety of measures; (3) Groups containing deliberate wits evaluated the group experience favorably; and (4) Groups containing deliberate wits did better on a problem-solving task than did other groups. (Contractor's abstract)

1656

Maudsley Hospital, London (Gt. Brit.).

THE EFFECT OF INTRAPITUITARY INFUSION OF MEDIAN EMINENCE AND OTHER BRAIN EXTRACTS ON ANTERIOR PITUITARY GONADOTROPHIC SECRETION, by H. J. Campbell, G. Feuer, and G. W. Harris. [1964] [15]p. incl. illus. tables, refs. (AFOSR-65-0036) (AF 61(514)953) AD 454836
Unclassified

Also published in Jour. Physiol. (London), v. 170: 474-486, 1964.

Infusions of extracts of the median eminence of the tuber cinereum, obtained from the brains of rabbits, cattle and monkeys, into the anterior pituitary gland of isolated female rabbits was found to excite secretion of gonadotrophic hormone (presumably LH) as shown by consequent ovulation in 55 out of 90 cases. Similar infusions into the pituitary gland of control brain extracts and other naturally occurring substances resulted in ovulation in only 6 out of 95 cases. Intravenous infusions of median-eminence extracts was found to evoke ovulation in 6 out of 23 rabbits. The conclusions is drawn that the median eminence contains some substance which excites the secretion of LH from the anterior pituitary gland of rabbits. It seems likely

that the release of this substance into the hypophysial portal vessels forms part of the neurohumoral mechanism controlling LH secretion.

1657

Maudsley Hospital, London (Gt. Brit.).

VASOPRESSIN AND THYROID FUNCTION IN THE RABBIT, by J. Garcia, G. W. Harris, and W. J. Schindler. [1964] [29]p. incl. diagrs. refs. (AFOSR-65-0037) (AF 61(514)953) AD 454837   Unclassified

Also published in Jour. Physiol, (London), v. 170: 487-515, 1964.

A method is described for measuring changes in thyroid activity in conscious unrestrained rabbits, based on the acute release of 1^{131} labelled compounds from the thyroid gland, as determined by measurements of blood radioactivity. With this method straight-line log. dose-response curves have been obtained to TSH given by intravenous infusion in doses between 10 and 1000 m-u. The action of synthetic and highly purified preparations of vasopressin on thyroid function in the rabbit have been studied. An increased thyroid activity is stimulated by 2 hr infusions of vasopressin at rates of 1.4-22.4 m-u/min. It has been shown that vasopressin does not act as a hypothalamic neurohumour increasing the discharge of pituitary TSH; nor does it act to release TSH from peripheral binding sites or to potentiate the action of circulating TSH.

1658

Maudsley Hospital, London (Gt. Brit.).

VASOPRESSIN AND THYROID FUNCTION IN THE RAT: THE EFFECT OF OESTROGENS, by G. W. Harris, S. Levine, and W. J. Schindler. [1964] [8]p. incl. diagr. tables, refs. (AFOSR-65-0038) (AF 61(514)953) AD 454710   Unclassified

Also published in Jour. Physiol. (London), v. 170: 516-523, 1964.

The thyroid response of normal male and female rats to injection of vasopressin has been studied by methods involving the uptake of 1^{131} by the thyroid, and the acute release of radio-iodinated compounds from the gland. No sign of increased thyroid activity was observed to follow administration of vasopressin to normal rats. Rats given three spaced injections of oestradiol benzoate over the preceeding 9 days showed an increased thyroidal activity, as assessed by the acute release method, following injection of vasopressin but not of oxytocin. (Contractor's abstract)

1659

Maudsley Hospital, London (Gt. Brit.).

CHEMICAL FACTORS IN THE EXCITATION OF

CEREBRAL TISSUES, by H. McIlwain. Final technical rept. May 1963, 16p. (AFOSR-4957) (AF EOAR-62-4) AD 413762 Unclassified

Mammalian cerebral tissues, electrically stimulated during incubation in isolation, showed a number of coordinated metabolic and electrical changes. Their respiratory rates increased in fashions which were quantitatively related to the duration, frequency, and potential of the stimulating pulses applied. Corresponding increase in movements of Na and K took place. Membrane potentials in cellular elements of the tissue diminished on stimulation and subsequently recovered; the time-course of diminution and recovery was directly connected with the concomitant ion movement. Chlorpromazine, phenobarbitone and cocaine in concentrations involved in their actions as drugs, and also clupeine, affected both ion movements and membrane potentials of the stimulated tissue. They did so in fashions which were characteristic of the added substance.

1660

Maudsley Hospital, London (Gt. Brit.).

SUBSTRATES AND THE POTASSIUM AND SODIUM LEVELS OF GUINEA PIG: CEREBRAL CORTEX SLICES IN VITRO: EFFECTS OF APPLICATION OF ELECTRICAL PULSES OF INHIBITORS AND OF ANOXIA, by P. Joanny and H. H. Hillman. [1963] [10]p. incl. diagrs. tables, refs. (AFOSR-J1315) (AF EOAR-63-1) AD 423995 Unclassified

Also published in Jour. Neurochem., v. 10: 655-664, 1963.

In the presence of group (I) substrates, 10 mM-glucose and 20 mM-lactate, the maximum in vitro K and Na gradients are found. With group (II) substrates, 10 mM-L-glutamate 10 mM-glucose mixture, 20 mM-pyruvate, 20 mM-fructose, 10 mM-L-glutamate (alone) and 20 mM-oxaloacetate, near-maximal non-inulin K concentrations were found, but higher Na (increasing in that order). Group (III) substrates, 20 mM-succinate and 20 mM-fumarate, gave no higher K and slightly higher Na than were found in the absence of substrate. Electrical stimulation for 10 min in the presence of all substrates tested and in the absence of added substrate, and after 3 hr, always caused a fall of K and rise of Na in the direction of their electro-chemical gradients. (Contractor's abstract)

1661

Maudsley Hospital, London (Gt. Brit.).

CHEMICAL FACTORS IN CEREBRAL EXCITATION, by H. McIlwain. Final technical rept. May 8, 1964, 14p. (AFOSR-64-1275) (AF EOAR-63-1) AD 602790 Unclassified

Membrane potentials recorded intracellularly from slices of cerebral cortex gave a mean value of 59 ± 10 mV (S.D.). Potentials were more stable in media containing 2.6 mM calcium than in media with 0.75

mM calcium. Small amounts of KCl were applied to the tissue surface, and calculated to give by diffusion concentrations of K up to 100 mM near the cells under observation. The KCl diminished the potentials, which subsequently recovered. Similar results were obtained by additions of sodium glutamate. Analysis of the tissue for Na, K, Cl and inulin showed that considerable gradients existed for these ions between tissue and incubation fluid; the gradients were compared with the observed membrane potentials.

1662

Maudsley Hospital, London (Gt. Brit.).

POLYBASIC AND POLYACIDIC SUBSTANCES OR AGGREGATES AND THE EXCITABILITY OF CEREBRAL TISSUES, ELECTRICALLY STIMULATED IN VITRO, by H. McIlwain. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-64-1703) (AF EOAR-63-1) AD 448260 Unclassified

Also published in Biochem. Jour., v. 90: 442-448, 1964.

Cerebral-cortical tissues lost their normal excitability on incubation in protamine-containing media, rinsing and examination in a second medium similar to the first but without protamine. Excitability could be restored by adding ganglioside preparations to the second medium. Phosphatidylserine and sulphatide preparations also restored excitability, but were required in greater concentrations than were the gangliosides. Chondroitin sulphates, suramin and polyglutamic acids (descending order of activity) also restored excitability. The effective agents complied with the following general description: they were polyacidic or existed in aqueous solution as polyacidic aggregates, and were required in quantities equivalent to or greater than the basic groups added to the tissue by the protamine with which it had been incubated. (Contractor's abstract, modified)

1663

Maudsley Hospital, London (Gt. Brit.).

ACTIONS OF HALOPERIDOL, MEPERIDINE, AND RELATED COMPOUNDS ON THE EXCITABILITY AND ION CONTENT OF ISOLATED CEREBRAL TISSUE, by H. McIlwain. [1964] [7]p. (AFOSR-64-1711) (AF EOAR-63-1) AD 447704 Unclassified

Also published in Biochem. Pharmacol., v. 13: 523-529, 1964.

Haloperidol, two other gamma-animobutyrophenones structurally related to it, meperidine and chlorpromazine were compared in their actions on isolated tissues from guinea pig cerebral cortex. Under ordinary metabolic conditions, the compounds were without effect on the respiration and on the sodium and potassium content of the tissues, and also on their chloride content and glycolysis in the instances examined. Response of the tissues to electrical stimulation was however, highly sensitive to the compounds, all of which inhibited respiratory response at a concentration of 10 mM. At higher concentrations, haloperidol increased the

sodium content of the stimulated tissue. Chlorproma-
zine also acted in this fashion, but the two other gamma-
aminobutyrophenones and meperidine, did not do so.

1664

Max-Planck-Inst. für Biologie, Tubingen (Germany).

PROCESSING OF INFORMATION AND CONTROL
PROCESSES IN BIOLOGICAL ORGANISMS, by W. E.
Reichardt. Final rept. Mar. 31, 1964, 11p. (AFOSR-
64-1064) (AF 61(052)232) AD 441482   Unclassified

This final report, written in summary form includes:
(1) Processing of optical information in the compound
eye of the horseshoe crab Limulus, (2) Analysis of
optomotor responses in insects, (3) The influence of
sinusoidally changing brightness densities onto the
mean pupil diameter of the human eye and the sub-
jective light intensity, (4) Quantitative relations be-
tween light stimulus and contraction of the musculus
sphincter pupillae of the toad Discoglossus pictus, and
(5) Relations between stimulus input and excitation out-
put in mechanoreceptors.

1665

Max-Planck-[Inst. für Strömungsforschung, Göttingen]
(Germany).

RADIOSONDE MEASURES AFTER-EFFECTS OF
SOLAR EVENTS, by E. Waibel. [1963] [5]p. incl.
diagrs. (AFOSR-64-0117) (AF EOAR-63-56)
AD 430669   Unclassified

Also published in Electronics, Apr. 19, 1963.

A balloon-borne radiosonde was developed to explore
phenomena initiated by solar events and accompanied
by x-rays and particle radiation in the auroral zone.
The system distinguishes between photons and charged
particles, which is required because both kinds of ra-
diation may occur after strong solar flares. The equip-
ment, which has operated successfully in several
flights over the polar regions of Europe, uses both a
scintillation counter and a counter telescope. Because
of this combination, the radiosonde can be readily
modified for a wide variety of radiation measurements
in the upper atmosphere. The system is also easily
adjusted and requires little time to make it ready for
flight. Design of the radiosonde was influenced by the
conditions under which it would operate.

1666

Max-Planck-Inst. für Strömungsforschung, Göttingen
(Germany).

RECENT EXPERIMENTAL INVESTIGATIONS ON THE
SCATTERING OF SOUND BY TURBULENCE, by D. W.
Schmidt. Apr. 1963, 23p. incl. illus. diagrs.
(AGARD rept. no. 461) (AFOSR-64-1279) (AF EOAR-
63-56) AD 443152   Unclassified

Presented at AGARD specialists' meeting on Mecha-

nism of Noise Generation in Turbulent Flow, Training
Center for Experimental Aerodynamics, Rhode-Saint
Genèse (Belgium), Apr. 1-5, 1963.

Experimental investigations of the scattering of sound
by turbulence were performed in a wind tunnel. Re-
cent theoretical predictions concerning the sound atten-
uation are well confirmed and partly extended by the
measurements. In the range of the parameters which is
of interest for practical applications the most important
results obtained are the proportionality of the sound at-
tenuation to the square of the sound frequency and to the
square of the turbulent Mach number. A formula is de-
rived from which the turbulent attenuation of directed
sound (such as aircraft noise in the free atmosphere)
can be calculated. A method for measuring large phase
variations is described in preliminary form; it will be
used to investigate the influence of turbulent scattering
on the phase angle of the sound waves. (Contractor's
abstract)

1667

Max-Planck-Inst. für Zellchemie, Munich (Germany).

THE BIOSYNTHESIS OF RUBBER, by J. Berndt. Final
technical rept. Nov. 30, 1963, 23p. (AFOSR-64-1136)
(AF EOAR-63-35) AD 601729   Unclassified

Isopentenyl pyrophosphate is incorporated into rubber
by latex (from Hevea brasiliensis) in the presence of
Mg ions. By removal of the isopentenylpyrophosphate
isomerase from latex it was shown, that dimethylallyl
pyrophosphate is necessary as a primer for the rubber
biosynthesis. Hence, the formation of the rubber mole-
cule is a de novo synthesis. The polymerase is Mg
dependent and is inhibited by SH-poisons, as could be
shown with latex freed from isopentenyl-pyrophosphate
isomerase.

1668

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

ON THE TWO-STATE MECHANISM FOR HOMOGENE-
OUS IONIC POLYMERIZATION, by B. D. Coleman
and T. G. Fox. [1964] [16]p. (AFOSR-64-1546)
(AF 49(638)541) AD 446126   Unclassified

Also published in Jour. Polymer Sci., Part C, 1964,
p. 345-360.

To explain the occasional occurrence of "stereoblock"
structures in homogeneous anionic polymerization of
alpha-olefins it was recently proposed that in these
polymerizations the reactive end of a growing polymer
can have several, say N, states (1), (2),..., (N) which
are in dynamic equilibrium and that each such state is
capable of adding monomer with its own rate and stereo-
specificity. It appears that for the present it is expedi-
ent to take advantage of the reduction in the number of
free parameters which results when N = 2, and to con-
sider in detail the consequences of a two-state mecha-
nism. Here are summarized those theoretical results

on the two-state model which appear to be accessible
to experimentation. The emphasis is on the diastereo-
sequence and molecular weight distributions.

1669

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

MONOTONICITY ON CURVES IN LIEU OF THE C-N
INEQUALITIES FOR FINITE ELASTICITY, by L. E.
Bragg. [1964] [12]p. (AFOSR-65-0327) (AF 49(636)-
541) AD 612239   Unclassified

Also published in Arch. Rational Mech. Anal., v. 17:
327-338, 1964.

It is shown that GCN inequality for the strain energy
function is equivalent to the monotonicity of some
scalar-valued functions defined over curves in the
6-dimensional space of symmetric tensors. The
theory of these curves is developed. (Math. Rev.
abstract)

1670

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THERMODYNAMICS OF MATERIALS WITH MEMORY,
by B. D. Coleman. [1964] [46]p. incl. refs. (AFOSR-
65-0368) (AF 49(638)541) AD 616039   Unclassified

Also published in Arch. Rational Mech. and Anal.,
v. 17: 1-46, 1964.

This paper attempts to lay the foundations of a thermo-
dynamic theory of simple materials; i.e., materials
for which the stress at time t is determined by the
history of the strain. The theory is developed from
basic equations for the stress, heat flux, specific in-
ternal energy, and specific entropy determined by the
deformation gradient, past temperature, and tempera-
ture gradient at time t. The concepts are macroscopic,
the physical principles being those of continuum phys-
ics: balance of momentum, balance of energy, equi-
presence, fading memory, material objectivity, and the
Clausium-Duhem inequality.

1671

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

[INFRARED SPECTRA OF SOLIDS]. Final rept. July
31, 1963, 1v. (AFOSR-J1189) (AF 49(636)542)
AD 439339   Unclassified

Studies have been made of: (1) Motion of molecules as a
whole in condensed phases; (2) Natural lines or band
widths of vibrational transitions in the solid state; and
(3) Orientation-dependent intermolecular forces.
Studies also included: Site splittings and Davydov split-
tings. Other research reported includes: IR studies of
free radicals and flash excitation.

1672

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

NUCLEAR MAGNETIC RESONANCE, by A. A.
Bothner-By, C. Naar-Colin and others. Summary
rept. [1963] 10p. (AFOSR-4709) (AF 49(636)960)
AD 615666   Unclassified

A summary is given of work on: (1) the nuclear mag-
netic resonance spectra of olefinic compounds; (2) rota-
tional isomerism in 2,3-disubstituted butanes; and (3)
methods of analyzing nuclear magnetic resonance
spectra.

1673

[Mellon Inst. Dept. of Chemistry, Pittsburgh, Pa.]

INELASTIC SCATTERING OF 390-V ELECTRONS BY
HELIUM, HYDROGEN, METHANE, ETHANE, CYCLO-
HEXANE, ETHYLENE, AND WATER, by E. N.
Lassettre and S. A. Francis. [1964] [10]p. (AFOSR-
64-1914) (AF AFOSR-63-61) AD 452257
                                      Unclassified

Also published in Jour. Chem. Phys., v. 40: 1208-
1217, Mar. 1, 1964.

Electron impact spectra obtained by the inelastic scat-
tering of 390-v electrons from helium, hydrogen,
methane, ethane, cyclohexane, ethylene, and water are
given. It is shown experimentally that, at small scat-
tering angles and a fixed velocity-analyzer setting, the
scattered current as a function of pressure contains a
maximum. The theory of this effect is discussed.

1674

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

COLLISION CROSS SECTIONS FOR OXYGEN IN THE
EXCITATION ENERGY RANGE 10 TO 60 V, by S. M.
Silverman and E. N. Lassettre. [1964] 11]p. (AFOSR-
64-1964) (AF AFOSR-63-61) AD 452497
                                      Unclassified

Also published in Jour. Chem. Phys., v. 40: 2922-
2932, May 15, 1964.

Inelastic, electronic, collision cross section for the
scattering of electrons of approximately 500-v kinetic
energy have been determined over the excitation energy
range 10 to 60 v. Generalized oscillator strengths are
calculated from the results and used to test the oscil-
lator sum rule. Extrapolated oscillator strengths are
compared with those calculated from ultraviolet absorp-
tion coefficients.

1675

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THEORETICAL CALCULATION OF ELECTRON

COLLISION CROSS SECTIONS FOR THE $1\,^1S \rightarrow 2\,^1P$ TRANSITION IN HELIUM, by E. N. Lassettre and E. A. Jones. [1964] [4]p. (AFOSR-64-2291) (AF AFOSR-63-61) AD 452691   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1218-1221, Mar. 1, 1964.

Using the Born approximation, collision cross sections for a transition in helium have been calculated. The wavefunctions employed are those used by J. A. Wheeler in the calculation of oscillator strengths.

1676

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

DETERMINATION OF GENERALIZED OSCILLATOR STRENGTHS FOR MOLECULAR HYDROGEN BY ELECTRON IMPACT, by E. N. Lassettre and E. A. Jones. [1964] [10]p. (AFOSR-64-2292) (AF AFOSR-63-61) AD 452690   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1222-1231, Mar. 1, 1964.

Inelastic electron collision cross sections at small scattering angles are determined for molecular hydrogen using electrons whose initial kinetic energies range from 324 to 461 v. Oscillator strengths have been calculated from the data and compared with values determined from ultraviolet absorption data by other investigators. The oscillator sum has been calculated and compared with theory and calculated refractive indices compared with experiment.

1677

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

NEW TYPES OF ORGANOSULFUR DERIVATIVES OF METAL CARBONYLS, by R. B. King and M. B. Bisnette. [1964] [2]p. (AFOSR-64-1535) (AF AFOSR-64-580) AD 446352   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 1267-1268, 1964.

This communication describes a new and entirely different synthesis of new types of organosulfur derivatives of metal carbonyls with metal-sulfur bonds. These new compounds have been obtained by thermal or photochemical decarbonylation of compounds of general formula $CH_3S(CH_2)_nM(CO)_x(C_5H_5)_y$ (n = 1, 2, or 3; M = Fe (x = 2, y = 1), Mo (x = 3, y = 1), or Mn (x = 5, y = 0)) without metal-sulfur bonds. These sulfur-containing transition metal alkyl derivatives, none of which has been previously reported, may in turn be obtained from metal carbonyl anions and the chloroalkyl methyl sulfides $CH_3S(CH_2)_nCl$.

1678

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

CYCLOPENTADIENYLCOBALT CARBONYL DIIODIDE, by R. B. King. [1964] [1]p. (AFOSR-65-0540) (AF AFOSR-64-580) AD 614540   Unclassified

Also published in Zeitschr. Naturforsch., v. 19: 1160, 1964.

Monomeric cyclopentadienylcobalt dicarbonyl, $C_5H_5Co(CO)_2$, reacts readily with iodine in diethyl ether solution at room temperature evolving CO and precipitating black crystalline cyclopentadienylcobalt carbonyl diiodide, $C_5H_5CoCOI_2$. This reaction is entirely analogous to the reaction of $Fe(CO)_5$ with iodine to give $Fe(CO)_4I_2$. The compound $C_5H_5CoCOI_2$ is also closely related to the perfluoroalkyl derivatives $C_5H_5CoCOR_fl$.

1679

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

AN ARYLAZO DERIVATIVE OF MOLYBDENUM, by R. B. King and M. B. Bisnette. [1964] [1]p. incl. refs. (AFOSR-65-0614) (AF AFOSR-64-580) AD 615355   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5694, 1964.

Reactions between aryldiozonium salts and many anions are useful both for the preparation of substituted aromatic compounds and for the preparation of arylazo compounds often useful as dyes. In attempts to prepare interesting aryl or arylazo complexes of various transition metals, investigations have been made of reactions between various aryldiozonium salts and various metal carbonyl anions. By this synthetic technique the first compound with an arylazo group, RN = N, directly bonded to a transition metal has been prepared.

1680

Melpar, Inc., Falls Church, Va.

RESEARCH ON THE ROLE OF LIPID PHASE TRANSITIONS IN BIOLOGICAL MEMBRANES, by I. Blei. Final rept. Sept. 1963, 27p. (AFOSR-J1175) (AF 49-(638)1176) AD 422943   Unclassified

A hypothesis of biological differentiation of sodium and potassium through lipid phase transitions in the bimolecular leaflets of biological membranes has been probed using lecithin micelles, which may be considered ordered, the temperature coefficient of the solubilizing power of lecithin for a sodium dye salt is negative and that for the potassium salt of the same dye, is positive. These results indicate that order-disorder transitions within biological systems may provide the physical basis for changes in ionic mobility in biological membranes.

1681

Miami U. Dept. of Chemistry, Coral Gables, Fla.

CYCLOPENTANE CONFORMATIONS: SOLVOLYSIS OF 3-SUBSTITUTED TOSYLATES, by I. Lillien and K. Khaleeluddin. [1964] [2]p. incl. table. (AFOSR-64-2203) (AF AFOSR-63-123) AD 452379   Unclassified

Also published in Chem. and Indus. (London), June 1964, p. 1028-1029.

The solvolytic behavior of 3-methyl-, and cis- and trans-3-butylcyclopentyl tosylates was compared with cyclopentyl tosylate itself, and almost negligibly small kinetic differences were found.

1682

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

KLEENE QUOTIENT THEOREMS, by J. D. McKnight, Jr. [1964] [10]p. (AFOSR-65-1165) (AF 49(638)1215) AD 623068   Unclassified

Also published in Pacific Jour. Math., v. 14: 1343-1352, 1964.

Generalizations are presented of the Kleene quotient theorem and the Converse theorems dealing with the properties of semigroups. The Kleene quotient theorem is generalized by removing the restriction that the semigroup be free. It then states that every element of a finite quotient of a finitely generated semigroup is a regular subset of the semigroup. The Converse theorems are altered by removing the restriction that the free semigroup be finitely generated. A new method of proof of the theorems is presented which is thought to be more transparent than the method of Kleene. In this method, transformation semigroups are avoided in the proofs of the Converse theorems by introducing a class of refinements of quotients. From this method, a finite automation is defined.

1683

Miami U. Dept. of Physics, Coral Gables, Fla.

NEW SYMMETRY GROUP FOR ELEMENTARY PARTI-CLES. I. GENERALIZATION OF LORENTZ GROUP VIA ELECTRODYNAMICS, by B. Kursunoglu. [1964] [8]p. incl. refs. (AF 49(638)1260) AD 450512
                                        Unclassified

Also published in Phys. Rev., v. 135: B761-B768, Aug. 10, 1964.

By using the definition of the photon angular momen-tum a connection between the Lorentz group and the unitary symmetry group of the strong interaction is es-tablished. The new group (to be called ILU_4 is a twen-ty-parameter group containing SU_3 and the inhomogene-ous Lorentz group as its subgroups. The spacetime and internal symmetries of dynamical systems may be

described by a single symmetry group. The new sym-metry group imparts a unitary content to every Lorentz frame of reference. (Contractor's abstract)

1684

Miami U. Dept. of Physics, Coral Gables, Fla.

BIVARIATE DISTRIBUTION FUNCTION FOR A PLAS-MA IN A MAGNETIC FIELD, by R. F. Polcyn. [1964] [2]p. (AFOSR-65-0096) (AF 49(638)1260) AD 455934
                                        Unclassified

Also published in Phys. Fluids, v. 7: 1719-1720, Oct. 1964.

The position-velocity distribution function for Brownian motion in a magnetized plasma is derived. From this derivation are deduced diffusion coefficients and the Fokker-Planck equation.

1685

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

FIELD EMISSION IN A MAGNETIC FIELD, by F. J. Blatt. [1963] 15p. incl. diagrs. refs. (AFOSR-4759) (AF 49(638)70) AD 406244; AD 409317   Unclassified

Also published in Phys. Rev., v. 131: 166-169, July 1, 1963.

An expression for the field-emission current in a longi-tudinal magnetic field is derived in the zero-tempera-ture limit. Two cases are considered, corresponding to constant Fermi energy (A) and constant electron den-sity (B). In both cases the calculated current density contains an oscillatory contribution periodic in 1/H, as well as a term which decreases as the square of the magnetic field. In case B, however, an oscillatory contribution appears that is absent in case A. Since the two oscillatory terms in case B differ in phase and their amplitudes depend on different powers of H, it should be possible to distinguish between cases A and B. The cur-rent-decrease quadratic in H has its origin in the steady diamagnetism of the electron gas. Using ac-cepted values of effective mass, Fermi energy, and work function, it was found that for bismuth the pre-dicted variations of the emission current with magnetic field should be readily observable.

1686

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

PARAMAGNETIC RELAXATION AT VERY LOW TEM-PERATURES. Final rept. 1963, 6p. (AFOSR-4455) (AF 49(638)613) AD 295892   Unclassified

Paramagnetic relaxation was examined in the following situations: (1) nuclear relaxation as a function of para-magnetic centers; (2) antiferromagnetic relaxation ex-amined by a probe nucleus or antiferromagnetic center;

(3) second sound generation by relaxation energy; (4) paramagnetic relaxation in color centers and centers produced by irradiation; and (5) paramagnetic relaxation at low fields and low frequencies.

1687

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

LATTICE-VIBRATION EIGENVECTORS AND APPLICATIONS THEREOF FOR NaCl AND KCl, by S. S. Jaswal and D. J. Montgomery. [1964] [5]p. (AFOSR-64-2522) (AF AFOSR-62-37) AD 453616
Unclassified

Also published in Phys. Rev., v. 135: A1257-A1261, Aug. 31, 1964.

Eigenvectors and eigenvalues for vibrations of the rocksalt lattice were computed in the harmonic approximation on the rigid-ion model and on a deformation-dipole model. The eigenvectors, furthermore, provide a basis for perturbation treatment. The frequencies of the local modes, and the corresponding amplitudes for impurity-atom vibrations, that result from point mass defects in NaCl and KCl, were also computed.

1688

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

INFRARED DISPERSION FREQUENCIES FOR ALKALI HALIDES, by C. M. Randall, R. M. Fuller and D. J. Montgomery. [1964] [3]p. (AFOSR-64-2539) (AF AFOSR-62-37) AD 454019   Unclassified

Also published in Solid State Commun., v. 2: 273-275, 1964.

Analysis of the photon-phonon interaction, among other phenomena requires knowledge of the optical behavior of crystals. The alkali halides, because of their simple properties, have been the subject of much recent work in lattice vibrations and in dispersion relations. One of the most important optical parameters for such studies, the infrared dispersion frequency ω_o, is most directly evaluated by observing the infrared absorption spectrum of thin films. Techniques were developed for the production and analysis of such spectra.

1689

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

A PROTON RESONANCE STUDY OF THE MAGNETIC STRUCTURE OF ANTIFERROMAGNETIC $CoCl_2 \cdot 6H_2O$, $CoBr_2 \cdot 6H_2O$, $NiCl_2 \cdot 6H_2O$, AND $NiBr_2 \cdot 6H_2O$, by R. D. Spence, P. Middents and others. [1964] [2]p. incl. diagr. tables. (AFOSR-64-1763) (AF AFOSR-63-430) AD 449053   Unclassified

Also published in Jour. Appl. Phys., v. 35: 654-855, Mar. 1964.

Studies of the antiferromagnetic states of $CoCl_2 \cdot 6H_2O$, $CoBr_2 \cdot 6H_2O$, $NiCl_2 \cdot 6H_2O$, and $NiBr_2 \cdot 6H_2O$ by proton resonance show that their magnetic space group must be either $P_c 2_1/a$ or $C_c 2/c$. The magnitudes of the local fields indicate that the Co salts belong to the former group and the Ni salts to the latter. (Contractor's abstract)

1690

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

PROTON RESONANCE STUDY OF ANTIFERROMAGNETIC $FeCl_2 \cdot 4H_2O$, by R. D. Spence, R. Au, and P. A. Van Dalen. [1964] [5]p. (AFOSR-65-0162) (AF AFOSR-63-430) AD 611477   Unclassified

Also published in Physica, v. 30: 1612-1616, 1964.

The proton resonance spectrum of $FeCl_2 \cdot 4H_2O$ has been examined in the temperature range 4.2K to 0.35K. Data obtained showed: (1) 4.2-1.1K-lines characteristic of the paramagnetic state; (2) 1.1-0.7K-no lines; and (3) 0.7-0.35K-lines characteristic of the antiferromagnetic state. Using the observed local fields and symmetry arguments a structure for the antiferromagnetic spin arrangement is proposed.

1691

Michigan U. Acoustics and Seismics Lab., Ann Arbor.

OPTICAL ANALYSIS TECHNIQUES APPLIED TO SEISMIC DATA, by P. L. Jackson. Semiannual technical summary rept. no. 5, June 15-Dec. 15, 1963. Jan. 1964, 10p. (AF 49(636)1076) AD 427360
Unclassified

The following tasks were performed: (1) Acquiring and using a scanning microphotometer for measurement and control of recordings and calibrations on variable-density film; (2) Improvement in the conversion, calibration, and measurement of seismograms from magnetic tape to variable-density film; (3) An extensive group of seismograms has been converted and is being frequency analyzed; (4) A laser has been introduced as a light source into the optical system; and (5) Arrangements have been made to obtain a commercial variable-density recorder for evaluation.

1692

Michigan U. [Acoustics and Seismics Lab.] Ann Arbor.

TIME-FREQUENCY SIGNATURES THROUGH OPTICAL DIFFRACTION SCANNING, by P. L. Jackson. Sept. 1963, 21p. (Rept. no. 4596 17R) (AF 49(636)1076) AD 419191   Unclassified

An optical scanning method has been developed to present frequency content as it occurs and changes throughout a variable-density seismogram. Energy distributions are shown in both frequency and time. A two-dimensional pattern is presented which can be visually evaluated, and is suitable for numerical measurement. It also describes a similar scanning method by which seismic wave dispersions can be revealed and measured.

1693

Michigan U. Acoustics and Seismics Lab., Ann Arbor.

INVESTIGATION OF AUDITORY DISCRIMINATION OF SEISMIC SIGNALS FROM EARTHQUAKES AND EXPLOSIONS, by G. E. Frantti and L. A. Levereault. Final rept. Apr. 1964, 39p. (Rept. no. 4595 14F; Rept. no. 5178 27T) (AF 49(638)1079) AD 437784
Unclassified

Magnetic tape recordings of short-period seismic signals from approximately 200 earthquakes and explosions were time-compressed by a factor of up to 512 to shift seismic frequencies to the audible range. Auditory experiments were conducted to determine the ability of the human auditory system to distinguish between seismic signals from earthquakes and explosions. The results of the experiments suggest that a trained listener can identify approximately two thirds of the seismic sounds presented.

1694

Michigan U. [Dept. of Chemical and Metallurgical Engineering] Ann Arbor.

SINTERING OF METAL OXIDES, by G. Parravano. Final rept. Oct. 1963, 28p. (AF 49(638)493) AD 602529
Unclassified

The research program had the following major objectives: (1) To determine the transport mechanisms which control the sintering of a representative group of metal oxides; (2) To relate the observed sintering mechanisms to fundamental properties of the solids (vapor pressure, diffusion coefficients, deviations from stoichiometric composition); (3) To investigate the role of whisker growth in metal oxides on their sintering behavior, and (4) To assess the influence of surface effects on sintering in oxide compounds.

1695

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

POLYMERIZATION OF STYRENE WITH $TiCl_3$-$Al(C_2H_5)_3$ AND VCl_3-$Al(C_2H_5)_3$ CATALYSTS, by F. D. Otto and G. Parravano. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-67-2643) (AF 49(638)606)
Unclassified

Also published in Jour. Polymer Sci., Part A, v. 2: 5131-5147, 1964.

The polymerization of styrene was studied in benzene solution with two catalyst systems: $TiCl_3$-$Al(C_2H_5)_3$ and VCl_3-$Al(C_2H_5)_3$. The rate of polymerization with VCl_3 as catalyst component was generally faster than the rate obtained with $TiCl_3$. A reaction scheme has been postulated to account for the influence of monomer and catalyst on the steady state rate. The model suggests that $TiCl_3$ activation consists of surface alkylation and removal of Cl^- ions by reaction with $Al(C_2H_5)_3$. Monomer adsorption occurs on vacant sites, neighboring alkylated surface sites, in competition with the adsorption of metal alkyl. Vacant and alkylated sites partake in the first coordination sphere of Ti^{+3} ions in $TiCl_3$. Polymerization follows by monomer insertion into the Ti—C bond at the alkylated site.

1696

Michigan U. [Dept. of Electrical Engineering] Ann Arbor.

EXPERIMENTAL STUDY OF "TONE DEAFNESS", by W. P. Tanner, Jr. and C. L. Rivette. [1964] [3]p. incl. tables. (AFOSR-2035) (AF 49(638)369) AD 453793
Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 1465-1467, Aug. 1964.

In a series of experiments designed to compare the efficiency of human observers in amplitude-discrimination tasks to their efficiency in frequency-discrimination tasks, the behavior of one of the 4 observers suggested that he was completely insensitive to frequency differences. The procedure of the experiments was then diverted to conduct an experimental case-study comparing the tone-deaf observer to 3 observers with normal frequency discrimination under a variety of experimental conditions. In amplitude-discrimination experiments in which he is detecting pulses of sine waves, he compares favorably. He far surpasses the other 3 observers when the signal is a sample of white Gaussian noise. (Contractor's abstract, modified)

1697

Michigan U. Dept. of Electrical Engineering, Ann Arbor.

[INVESTIGATION IN THE THEORY OF SPHEROIDAL AND MATHIEU FUNCTIONS], by F. B. Sleator. Final rept. June 1964, 10p. (AFOSR-64-1274) (AF AFOSR-63-289) AD 602787
Unclassified

The objective of this investigation was to develop and exploit new relations between the spheroidal functions and other better known functions which might reduce the labor and complication involved in obtaining new numerical values of the spheroidal functions and thus facilitate the quantitative solutions of new spheroidal diffraction problems or the extension of existing solutions into ranges not previously covered. Although the present

forms should give values sufficiently accurate for practical applications, it is clear that they are more suitable for filling in gaps in existing tables as the need arises than for large-scale production of new ones.

1698

Michigan U. [Dept. of Electrical Engineering] Ann Arbor.

MONOTONE REDUCTION ALGORITHMS, by R. F. Arnold and D. L. Richards. [1964] [2]p. (AFOSR-65-0583) (AF AFOSR-64-367) AD 619281 Unclassified

Also published in Internat'l. Conf. on Microwaves Circuit Theory, and Information Theory, Tokyo (Japan) (Sept. 1964). Tokyo, Inst. of Electrical Communication Engineers of Japan, Summaries of Papers, Part 3, 1964, p. 175-176.

A summary is given of a paper which considers a class of algorithms which are appropriate for a two-sided congruence relation on words. The main body of the paper is devoted to showing that a finite rank ordered work problem always has a unique best monotone reduction algorithm, and that this core algorithm is the unique result of self-applying an arbitrary reduction algorithm.

1699

Michigan U. [Dept. of Mathematics] Ann Arbor.

KOSINSKI'S r-SPACES AND HOMOLOGY MANIFOLDS, by C. N. Lee. [1963] [5]p. (AFOSR-4281) (AF 49-(638)774) AD 424231 Unclassified

Also published in Michigan Math. Jour., v. 10: 289-293, 1963.

The purpose of the present paper is to show that a connected r-space is a (locally orientable) singular homology manifold over an arbitrary coefficient field. This may be considered as an explanation of the fact that r-spaces resemble topological manifolds. It is further shown that a connected HLC r-space is a (locally orientable) singular homology manifold over any principal ideal domain K, and hence a Cech cohomology manifold over K.

1700

Michigan U. [Dept. of Mathematics] Ann Arbor.

INTEGRAL REPRESENTATIONS OF AXIALLY SYMMETRIC POTENTIAL FUNCTIONS, by A. E. Heins and R. C. MacCamy. [1963] [13]p. (AFOSR-J1211) (AF AFOSR-62-341) AD 424270 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 13: 373-385, 1963.

Solutions are given for elliptic partial differential equations in 3 variables when there is an axis of symmetry. A uniqueness theorem is proved which

illustrates connection between elliptic partial differential equations with analytic coefficients and hyperbolic partial differential equations. This suggests an existence theorem which is proved by obtaining an analog of the Laplace integral by constructing a convergent successive approximation procedure. The connection between the regularity of the solution and the analyticity of the boundary data at r = 0 is also discussed.

1701

Michigan U. [Dept. of Mathematics] Ann Arbor.

ON DIFFRACTION BY A HALF-PLANE, by A. E. Heins. [1964] [8]p. (AFOSR-64-2423) (AF AFOSR-62-341) AD 454962 Unclassified

Also published in Jour. Math. Pures et Appl., v. 43: 59-66, 1964.

The mathematical theory of diffraction, as it pertains to the half-plane, has been an object of much investigation. Various mathematical methods have been employed to discuss three cases of interest; that is, plane wave excitation, cylindrical wave excitation (the line source) and spherical wave excitation (the point source). This paper discusses yet another method which brings the problem within the realm of the classical theory of functions of a complex variable and some properties of the Fourier transform theorem.

1702

Michigan U. Dept. of Mathematics, Ann Arbor.

NON-EQUILIBRIUM HYDRODYNAMICS OF A CHEMICALLY REACTING FLUID, by C. Yuan. Progress rept. Sept. 1963, 33p. incl. refs. (AFOSR-5514) (AF AFOSR-63-20) Unclassified

Two topics are studied: (I) the thermodynamics (and hence the energy relations) for a chemically reacting fluid with heat of reaction effects; and (II) the upper and lower limiting speeds of "linearly perturbed motions" in the fluid. The first of the above leads to the study of two types of relations: (1) the usual extent of reaction equation; (2) linear phenomenological equations for the heat flux and rate of reaction in terms of the affinity and temperature. For the limit speeds, the following results are obtained: (a) in the low frequency case, the limit speed coincides with that of Broer, Stupochenko-Stakhanov and is independent of heat of reaction; and (b) in the high frequency case, the limit speed is independent of the chemical reaction. (Contractor's abstract, modified)

1703

Michigan U. [Dept. of Mathematics] Ann Arbor.

THE CAUCHY PROBLEM AND ENTROPY IN CHARGED COMPRESSIBLE RELATIVISTIC SELF-INDUCTIVE FLUIDS, by N. Coburn. [1963] [18]p. incl. refs. (AFOSR-64-0971) (AF AFOSR-63-20) AD 440143 Unclassified

Also published in Relativistic Fluid Mechanics and Magnetohydrodynamics, New York, Academic Press, 1963, p. 43-60.

The paper is divided into 2 parts. In Part I, the Cauchy problem for 3 hyperbolic systems of partial differential equations is studied. In Part II, the study is limited to the determinations of the modifications in the basic Cauchy equations of the noninductive case for the case when self-induction is present. The self-induction terms are defined and enter into the Maxwell equations. Since these terms also enter into the entropy relation, it is determined how these terms effect the entropy relation, and then how these terms effect the basic Cauchy equations.

1704

Michigan U. [Dept. of Mathematics] Ann Arbor.

ALMOST ACYCLIC MAPS OF MANIFOLDS, by K. W. Kwun and F. Raymond. [1964] [13]p. (AFOSR-66-2027) (AF AFOSR-63-373) AD 642985   Unclassified

Also published in Amer. Jour. Math., v. 86: 638-650, July 1964.

A map is called proper if the inverse image of each compact set is compact. A proper map is said to be acyclic over a coefficient domain L if each point inverse is cohomologically trivial over L. A map f: (X, A) → (Y, B) is admissible if (1) f is proper, (2) (X, A), (Y, B) are locally compact Hausdorff closed pairs and (3) f(A) = B and f(X-A) = Y-B. This paper deals with the following question: Suppose f: (X, A) → (Y, B) is an admissible map such that f|X-A is acyclic. Under what conditions is f acyclic? Also, the paper studies the cohomology of the set A when f: (X, A) → (Y, B) is an admissible map between manifolds. The main theorems state what conditions on f, A, B, X, Y are necessary so that f is acyclic.

1705

Michigan U. [Engineering Psychology Group] Ann Arbor.

RESEARCH ON DECISION PROCESSES, by W. Edwards. Final rept. Dec. 1, 1961-Mar. 29, 1963. June 1963, 17p. (Rept. no. 4902 5F) (AFOSR-5047) (AF AFOSR-62-182) AD 415158   Unclassified

The statement of research work read in part as follows: (a) Probability feedback in sequential decision making will be studied by determining courses of action whose probabilities of success will be well-defined functions of the subject's previous choices. (b) Probability tracking will be studied by determining courses of action whose probabilities of success vary according to some well-defined function of the number of elapsed trials. (c) The psychophysics of probability will be studied by determining the psychophysical properties, in particular the size of just noticeable difference, of sequential and simultaneous displays of probabilities. (d) Theoretical work on general decision making will be done including updating of existing literature surveys.

1706

Michigan U. Engineering Psychology [Group] Ann Arbor.

RESEARCH ON DECISION PROCESSES, by W. Edwards. Final rept. Apr. 1, 1963-Mar. 31, 1964. July 1964 [15]p. incl. table, refs. (Rept. no. 5569-1-F) (AF AFOSR-63-192) AD 604488   Unclassified

The report consists of an annotated reference list concerning articles and speeches published, in press, or still in preparation on decision making. In the case of published articles, the annotation is the published summary or abstract of the article, with the addition of a few comments indicating its status in the research program. All articles and speeches resulting from the whole four-year research program are included; an attempt is made to identify the sources of support of each.

1707

Michigan U. [Engineering Psychology Group] Ann Arbor.

BASES FOR PREFERENCES AMONG THREE-OUTCOME BETS, by S. Lichenstein. May 1964, 22p. (AF AFOSR-63-192) AD 600139   Unclassified

This experiment compared the moment functions of a bet as predictors of choices among bets with the subjectively expected utility (SEU) maximization model. Bet parameters of Expected Value (EV), Variance (V), Skewness (Sk), and probabilities were independently varied in 182 3-outcome bets. Each of 12 Ss bid on each bet and played some bets for real money. Ss preferred high EV and low V, but had no preferences within Sk or probability levels. Sets of bets existed which were equal in all parameters; within such sets, Ss preferred bets with the largest least likely amount. The moment-function approach was rejected; the SEU model was not. A lexicographic ordering of variables was suggested.

1708

Michigan U. Inst. of Science and Tech., Ann Arbor.

ANALOG COMPUTATION OF TIME-VARYING POWER SPECTRA OF SEISMIC WAVES, by V. L. Larrowe and R. E. Crabtree. Apr. 1963, 62p. (Rept. no. 5178 8T; Rept. no. 3708 15T) (AFOSR-4696) (AF 49(638)911 and AF 49(638)1170) AD 403084   Unclassified

An analog computing technique for measuring time-varying power spectra of seismic signals was developed. The signal to be analyzed is recorded on a magnetic-tape loop so that it may be played back repeatedly, and the analog computing equipment, connected to the output of the tape-playback apparatus, measures as a function of time the power level at a different specific frequency for each passage of the tape. The concept of a time-varying spectrum is developed and the theory of the analysis method used is derived.

1709

Michigan U. Inst. of Science and Tech., Ann Arbor.

DIFFERENTIATION OF EARTHQUAKES AND UNDER-
GROUND NUCLEAR EXPLOSIONS ON THE BASIS OF
AMPLITUDE CHARACTERISTICS, by D. E. Willis,
J. DeNoyer, and J. T. Wilson. [1963] [9]p. incl.
illus. diagrs. (AFOSR-5352) (AF 49(636)1170)
                                    Unclassified

Also published in Bull. Seismol. Soc., v. 53: 979-
987, Oct. 1963.

The particle velocity ratios of the maximum shear-
surface waves to maximum compressional waves were
determined for a large number of earthquakes recorded
over a wide geographic range. These results are com-
pared with similar types of data for underground nu-
clear detonations recorded in the United States. It was
found that this technique could be used as a diagnostic
aid in distinguishing between these two types of sources
at distances less than 1000 km. (Contractor's abstract)

1710

Michigan U. [Inst. of Science and Tech.] Ann Arbor.

ENERGY SPECTRA FOR UNDERGROUND EXPLO-
SIONS AND EARTHQUAKES, by G. E. Frantti. [1963]
[9]p. incl. diagrs. tables. (AFOSR-5353) (AF 49(638)-
911 and AF 49(638)1170)   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53:
997-1005, Oct. 1963.

Energy density for the entire seismogram is examined
as a function of frequency for underground explosions
and earthquakes. Anomalous differences in the spectra
appear to correlate with the time duration of the source.
Ratios of aftershock to earthquake energy show a rela-
tively flat frequency dependence. In contrast, cor-
responding ratios for nuclear shot-collapse events
change rapidly with increasing frequency. Analysis of
these data suggests that measurements of total seismo-
gram energy might be usefully applied in the seismic
source discrimination problem. (Contractor's abstract)

1711

Michigan U. [Inst. of Science and Tech.] Ann Arbor.

SPECTRAL ENERGY DENSITY FOR QUARRY EXPLO-
SIONS, by G. E. Frantti. [1963] [8]p. incl. diagrs.
(AFOSR-5357) (AF 49(636)911 and AF 49(636)1170)
                                    Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53:
989-996, Oct. 1963.

Several explosions of varying time duration have been
recorded at 156 km along a constant propagation path
from a central Michigan limestone quarry. Energy
density for body waves and surface waves is examined
as a function of frequency and observed to peak between
1 and 10 cps. A correlation between spectral

amplitudes and source duration time is revealed and is
emphasized at shot durations which approximate the
dominant period of seismic waves. A study of the data
suggests that seismic energy levels may be controlled,
in part, by regulating the time duration of delayed quar-
ry blasts. This parameter (total duration time) has
been generally neglected in published studies involving
commercial blasts. (Contractor's abstract)

1712

Michigan U. Inst. of Science and Tech., Ann Arbor.

AN EXPERIMENTAL STUDY OF SOURCE MOTION
SYNTHESIS FROM FIRST ARRIVALS, by H. N. Pollack.
[1963] [9]p. incl. diagrs. refs. (AFOSR-5472)
(AF 49(638)1078 and AF 49(636)1170)   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53:
955-963, Oct. 1963.

The motion near a seismic source is synthesized from
experimentally obtained seismograms of non-dispersed
body waves. The body waves were emitted from an ex-
plosive source submerged in a lake with a frozen sur-
face. The seismograms were recorded at several dis-
tances. These results indicate that over the short
propagation distances, the observed waveforms and
their associated spectra retain characteristics of the
source function. The records also yield some informa-
tion regarding the nature and structure of the elastic
medium about the source. (Contractor's abstract,
modified)

1713

Michigan U. Inst. of Science and Tech., Ann Arbor.

SHORT PERIOD SPECTRAL MEASUREMENTS OF
SEISMIC WAVES IN THE NORTHEASTERN U.S.A.,
by D. E. Willis. [1964] [13]p. incl. illus. diagr.
(AFOSR-65-2911) (AF 49(636)1170) AD 448923
                                    Unclassified

Also published in Earthquake Notes, v. 35: 1-13,
Mar.-June 1964.

An investigation of the high-frequency energy content
of seismic waves propagated out to distances of several
100 km. is reported for the northeastern portion of the
United States. Recordings were obtained on magnetic
tape using broadband equipment for earthquake and
high-explosive sources. Significant amounts of high-
frequency seismic energy in the range from 10-20 cps
were found in both type sources. Similar type meas-
urements made in southwestern areas of the United
States show little evidence of this high-frequency en-
ergy. (Contractor's abstract)

1714

Michigan U. [Inst. of Science and Tech.] Ann Arbor.

METHODS OF SPECTRAL ANALYSIS OF SEISMIC

DATA, by I. K. McIvor. [1964] [20]p. (AFOSR-65-
2912) (AF 49(638)1170) AD 453601   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
1213-1232, Aug. 1964.

Three different methods of spectral analysis are com-
pared on the basis of a common interpretation in terms
of time-varying Fourier analysis. The spectra ob-
tained by these methods for a particular seismic event
are given and differences in the results are resolved.

1715

Michigan U. Inst. of Science and Tech., Ann Arbor.

ELASTIC AND ACOUSTIC WAVES RADIATED FROM
CYLINDRICAL MEDIA ABOUT A POINT SOURCE, by
W. C. Meecham and J. M. DeNoyer. Nov. 1963, 21p.
(Rept. no. 3649 23T; Rept. no. 5178 14T) (AF 49(638)-
1170) AD 423016   Unclassified

The theory for 3 related but different problems is con-
sidered. These problems involve finding the radiation
pattern from simple harmonic sources in various types
of media geometries which can be represented by cyl-
indrical surfaces. The first problem is a conside.ation
of a point source on the axis of an elastic circular cyl-
inder which is completely surrounded by an infinite
elastic medium of different properties. The second
and third problems are acoustic or two-fluid problems.
A free surface has been introduced in both these ex-
amples.

1716

Michigan U. [Inst. of Science and Tech.] Ann Arbor.

HIGH FREQUENCY MICROEARTHQUAKES RECORDED
AT QUETTA, PAKISTAN, by J. [M.] DeNoyer. [1964]
[7]p. (AF 49(638)1170) AD 612437   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54:
2133-2139, Dec. 1964.

Numerous high frequency microearthquakes were re-
corded on a special portable magnetic tape recorded at
Quetta, Pakistan, during the summer of 1962. These
microearthquakes have maximum particle velocities
between 30 and 50 cps. Many of the foci appear to be
almost directly under the recording station. The focal
distance for the nearest of these earthquakes appears
to be less than 1 km. The source for these earthquakes
may result from 'bedding plane slippage' as strain ac-
cumulates in sediments adjacent to a high angle fault.

1717

Michigan U. [Research Center for Group Dynamics]
Ann Arbor.

PERCEPTION, DRIVE AND BEHAVIOR THEORY, by
R. B. Zajonc and D. D. Dorfman. [1964] [24]p.
(AFOSR-64-2255) (AF 49(638)367) AD 452343
                Unclassified

Also published in Psychol. Bull., v. 62: 267-290,
July 1964.

The role of perceptual variables in Behavior Theory
was examined in terms of their implications for stimu-
lus-intensity generalization and discrimination learn-
ing. Examination of the so-called sensory-interaction
effects seriously questioned the validity of the afferent
stimulus-interaction postulate. Results of experiments
on stimulus-intensity generalization and discrimination
learning were found to conflict with the predictions de-
rived from Behavior Theory, supporting the view based
on sensory-interaction effects.

1718

Michigan U. Research Center for Group Dynamics,
Ann Arbor.

RELATIONSHIP BETWEEN WORD FREQUENCY AND
RECOGNITION: PERCEPTUAL PROCESS OF RE-
SPONSE BIAS? by R. B. Zajonc and B. Nieuwenhuyse.
[1964] [10]p. incl. diagrs. table. (AFOSR-65-0712)
(AF AFOSR-63-21) AD 616821   Unclassified

Also published in Jour. Exper. Psychol., v. 67: 276-
285, Mar. 1964.

Functions relating word frequency to recognition thresh-
old and to pseudo-recognition threshold were compared
for 24 Dutch Ss. Luminance thresholds were obtained
to 10 Turkish words previously shown with frequencies
of 1, 2, 5, 10, and 25. Pseudo-recognition thresholds
were obtained in the absence of stimuli for the same
words and the same Ss. Drive was manipulated to de-
termine whether it interacts with frequency, taking this
interaction as an indication of response bias. The com-
parison of the frequency-threshold functions, the ab-
sence of a drive-frequency interaction, and the decreas-
ing dependence of response emission on prior training
with increasing stimulus information, demonstrated
that response bias plays a negligible role in the fre-
quency-recognition relationship when stimuli are pres-
ent and when a stringent recognition criterion is em-
ployed. (Contractor's abstract)

1719

Microwave Electronics Corp., Palo Alto, Calif.

PROPAGATION, DISPERSION, AND ATTENUATION
OF BACKWARD-TRAVELING MAGNETOSTATIC
WAVES IN YIG, by F. A. Olson and J. R. Yaeger.
[1964] [3]p. incl. diagrs. (AFOSR-65-0898) (AF 49-
(638)1330) AD 617452   Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 33-35,
July 15, 1964.

The propagation of long-wavelength spin waves were ob-
served in single-crystal rods of yttrium iron garnet
(YIG). These magnetostatic waves were propagated
along the axis of YIG rods, ~ 0.1 cm^2 cross section
area, 0.8 to 1.6 cm length, and of variant crystal
types. There was no significant variation in results be-
tween the varieties of crystals tested. The dispersion

characteristics of the waves are determined, and from attenuation measurements relaxation times are estimated at a number of microwave frequencies. The propagation velocity and propagation attenuation are also discussed. The fit of the data further substantiates that the transmission through the YIG sample is due to magnetostatic waves which propagate as highly dispersive backward waves.

1720

Midwest Research Inst., Kansas City, Mo.

RESEARCH ON PANEL FLUTTER OF CYLINDRICAL SHELLS, by R. O. Stearman. Final rept. Jan. 1964, 96p. (AFOSR-64-0074) (AF 49(636)1169) AD 430829; AD 430991   Unclassified

A theoretical study was made on the panel flutter characteristics of a ring and longeron stiffened circular cylindrical shell at high supersonic Mach number. This study is an extension of an earlier program and uses the cyclic reduction procedure developed there to simplify the flutter analysis. This actual reduction procedure is included for completeness. An improved modal analysis was employed in this study which leads to an increased understanding of the flutter behavior of such complex structures at the high supersonic Mach numbers. A method for extending the above analysis to the lower supersonic Mach numbers is also discussed.

1721

Midwest Research Inst., Kansas City, Mo.

FLUTTER OF A RING OF PANELS, by R. Stearman. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1679) (AF 49(638)1169) AD 450312   Unclassified

Also published in AIAA Jour., v. 2: 1441-1448, Aug. 1964.

A theoretical investigation has been made of the flutter characteristics of a ring and longeron-stiffened cylindrical shell whose outer surface is exposed to a supersonic flow parallel to its axis. It is shown that the flutter analysis of this configuration can be reduced to the analysis of an equivalent single panel using the circulant matrix idea. An approximate flutter solution is obtained for this configuration in the limit when the number of panels become large, and the unsteady aerodynamic pressures may be computed from simple linear piston theory. (Contractor's abstract, modified)

1722

Midwest Research Inst., Kansas City, Mo.

RESEARCH ON PANEL FLUTTER, by R. O. Stearman. Final technical rept. Dec. 1964, 36p. incl. illus. diagrs. tables, refs. (AFOSR-65-0247) (AF 49(638)-1324) AD 614801   Unclassified

During this past year the theoretical approach to the thin shell panel flutter studies at Midwest Research

Institute was extended to include an experimental program. The basic objective of this program is concerned with the influence of an external flow field on the stability characteristics of thin cylindrical shells. The significant accomplishments attained during the year's research effort include the design and fabrication of a cylindrical shell flutter model, its supporting instrumentation, and a thin shell electro-forming facility for fabricating the flutter shells. These combined accomplishments will permit a first correlation of experimental shell stability studies at the lower supersonic Mach numbers.

1723

Milan U. (Italy).

[OXYGEN AND HYDROGEN PEROXIDE ELECTRO-CHEMICAL PROCESSES ON CHROMIUM ELECTRODES] Processi elettrochimici dell'ossigeno e dell'acqua ossigenata su elettrodi di cromo, by T. Mussini. [1963] [5]p. incl. diagrs. refs. (AFOSR-64-1611) (AF 61-(052)260) AD 449084   Unclassified

Also published in Chim. e Indus. (Milan), v. 45: 679-683, June 1963.

The cathodic progress of oxygen as well as the cathodic and anodic processes of hydrogen peroxide on chromium electrodes have been studied, and the singular behavior of chromium with regards to the aforementioned processes has been brought into evidence. On the basis of the polarization curves experimentally obtained, the mechanism of the oxygen cathodic reduction on chromium has been outlined; moreover the mechanism has been studied of the cathodic inhibition by chromates in the oxygen reduction process, also relating this mechanism to the one of oxygen cathodic reduction on chromium.

1724

Milan U. Inst. of General Chemistry (Italy).

HYDRIDO AND CARBONILHYDRIDO IRIDIUM COMPOUNDS, by L. Malatesta, M. Angoletta, and G. Caglio. [1964] [3]p. incl. diagrs. refs. (AFOSR-64-2200) (AF EOAR-64-9) AD 453616   Unclassified

Also published in Proc. Eighth Internat'l. Conf. on Coordinating of Chemistry, Vienna (Austria) (Sept. 7-11, 1964), 1964, p. 210-212.

Using as ligand triphenylphosphine (=L) IrH_3L_2 the unsaturated hydride IrH_3L_2 was prepared, as well as the hydridocarbonyl (triphenylphosphine) iridium compounds $IrHCOL_2$ and $IrH_3 COL_2$, and the related organometallic derivative $Ir(COOR)(CO)_2L_2$.

1725

Milan U. Inst. of General Chemistry (Italy).

HYDRIDO-COMPLEXES OF TRANSITION METALS. PART I. HYDRIDO-COMPLEXES OF RHODIUM(I),

COBALT(1), AND COBALT(III), by A. Sacco and R. Ugo. [1964] [5]p. incl. diagr. table, refs. (AFOSR-65-0237) (AF EOAR-64-9) AD 611362   Unclassified

Also published in Jour. Chem. Soc. (London), Sept. 1964, p. 3274-3278.

The preparation and properties are described of complex-salts of rhodium. From these compounds, a very stable hydrido-complex of rhodium has been prepared by reduction with lithium aluminum hydride or sodium borohydride. The product of the reaction between $[CoBr_2[C_2H_4(PPh_2)_2]_2]$ and sodium borohydride is shown to be a hydrido-complex of cobalt. The formula of this complex is supported by the diamagnetism of the compound, by its reaction with carbon tetrachloride to give chloroform. On the ground of their dipole moments and of their isomorphism with $[Ni{C_2H_4(PPh_2)_2]_2]$, a non-orthogonal structure for these hydrido-complexes of rhodium and cobalt is suggested. (Contractor's abstract, modified)

1726

Milan U. Inst. of General Chemistry (Italy).

BASIC BEHAVIOUR OF SOME PLATINUM (O) DE-RIVATIVES, by F. Cariati, R. Ugo, and F. Bonati. [1964] [2]p. incl. table. (AFOSR-65-0236) (AF EOAR-64-9) AD 611383   Unclassified

Also published in Chem. and Indus. (London), 1964, p. 1714-1715.

Zerovalent Pt derivatives of PtL_3 general formula $(L = PPh_3$ or $AsPh_3)^3$ have been found to have basic behavior analogous to the reaction of some transition metal complexes, such as the reversible reactions of $[\pi-C_5H_5)_2ReH]^1$ or $[Fe(CO)_3(PPh_3)_2]^2$ with acids to give hydrides.

1727

Milan U. Inst. of General Chemistry (Italy).

[NEW TRIPHENYLPHOSPHINE HYDRIDES OF RHENIUM] Nuovi idruri trifenilfosfinice di renio, by L. Malatesta, M. Freni, and V. Valenti. [1964] [9]p. incl. diagrs. tables. (AFOSR-65-0611) (AF EOAR-64-9) AD 614207   Unclassified

Also published in Gazz. Chim. Ital., v. 94: 1276-1286, 1964.

The preparation and the properties of the rhenium, triphenylphosphinehydrides ReH_5L_2 and ReH_5L_3 [L = $(PC_6H_5)_3$], are described. They are obtained by the reactions that allowed us to isolate the hydrides ReH_3L_2, $ReH_3L_2 \cdot 2C_2H_5OH$ and ReH_3L_4 previously prepared in these laboratories. They are crystalline, non-electrolyte diamagnetic substances and t⁺   : -frared and nuclear magnetic resonance spectr.   ᵗhose expected on account of their hydridic structure.

1728

Milan U. Inst. of Physics (Italy).

THERMOLUMINESCENCE IN PLASTICALLY DE-FORMED KBr, by R. Fieschi, R. Oggioni, and G. Spinolo. [1963] [7]p. incl. diagrs. refs. (AFOSR-J1141) (AF EOAR-63-27) AD 421723   Unclassified

Also published in Phys. Stat. Solidi, v. 3: 1207-1213, 1963.

The thermoluminescence of plastically deformed KBr crystals is measured in the temperature range 60-350°K for differing amounts of deformation. It is found that the glow peaks characteristic of undeformed crystals are greatly enhanced but that no new glow peaks appear. The effect of annealing at different temperatures, before x-ray excitation shows that the enhanced emission is not due to direct trapping of carriers by dislocations. The study of changes in the absorption spectra indicates that there is no correlation between coloration and enhanced emission of different deformed samples. (Contractor's abstract)

1729

Milan U. Inst. of Physics (Italy).

THERMOLUMINESCENCE INDUCED BY PLASTIC DE-FORMATION IN ALKALI HALIDES, by E. Panizza. [1964] [2]p. incl. diagrs. table, refs. (AFOSR-64-1995) (AF EOAR-63-27) AD 452509   Unclassified

Also published in Phys. Ltrs., v. 10: 37-36, May 15, 1964.

It is well known that light and electrons are emitted by alkali halide single-crystals during plastic deformation. It seems that color centers and in general x-ray charged traps are ionized by interaction with dislocations moving through the sample during plastic deformation. The primary purpose of our research has been to study this interaction by also taking into account the radiationless capture of carriers freed from the x-ray charged traps, by deformation.

1730

Milan U. [Inst. of Physics] (Italy).

SURFACES AND DISLOCATIONS IN ALKALI HALIDES, by R. Fieschi. Final rept. Oct. 1, 1962-Sept. 30, 1964. Nov. 30, 1964, 59p. incl. diagrs. tables, refs. (AFOSR-65-0365) (AF EOAR-63-27) AD 611762
                                                    Unclassified

This research dealt mainly with the influence of plastic deformation on the thermoluminescence (TL) of alkali halide single crystals; the work was expanded to include the study of TL in undeformed crystals in order to clarify the nature of the various traps. The influence of plastic deformation on dipolar complexes $(Sr^{++} +)$ in doped samples was studied by means of

ionic thermoconductivity, a method recently conceived. Some work was done also on the absorption edge and on the manganese ESR in deformed samples.

1731

Milan U. Inst. of Physics (Italy).

[IONIC SURFACE RELAXATION IN POWDERS OF AL-KALI HALIDES] Rilassamenti ionici superficiali in polveri di alogenuri alcalini, by C. Bucci. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-65-1784) (AF EOAR-63-27) AD 626353   Unclassified

Also published in Proc. Sixty-fifth Annual Meeting of the AEI (Palermo), No. 67: 1-5, 1964.

An experimental investigation of the dielectric surface relaxation in the alkali halides is presented. A study is made of powdered KCl, both pure and contaminated with $SrCl_2$, ionized with the aid of thermocurrents in the temperature range between LNT and 250°C. The thermocurrent bands at 210°K were attributed to Maxwell Wagner relaxation. In particular, from the 210°K band one deduces an activation energy of 0.35 ev and a frequency factor of 10^8; these values may correspond to free surface motion. The activation energy values and the frequency factor for the 460°K band are in agreement with the typical value of free motion in larger volumes.

1732

Minnesota U., Minneapolis.

INVESTIGATION OF MAGNETIC RESONANCE IN STRONGLY COUPLED DIPOLE SYSTEMS, by A. H. Morrish. Final rept. June 16, 1960-June 15, 1963. July 1963, 47p. incl. diagrs. tables, refs. (AFOSR-J1112) (AF 49(636)603) AD 416424; AD 421126
                                    Unclassified

The first part of this report is a summary of the accomplishments made during the course of this entire contract. The last part of the report describes in some detail those parts of the research not yet published. This latter material is discussed under the following four headings: (1) Initial permeability of polycrystalline garnets; (2) The influence of thin-film boundary conditions on spin-wave spectra; (3) Studies of large single crystal garnets; and (4) Resonance in single crystal garnets.

1733

Minnesota U., Minneapolis.

NATURAL SPECTRUM OF POLYCRYSTALLINE YIG AS A FUNCTION OF DENSITY, by J. D. Holm and A. H. Morrish. [1964] [2]p. (AFOSR-64-1246) (AF 49(636)803) AD 442800   Unclassified

Also published in Jour. Appl. Phys., v. 35: 894-695, Mar. 1964.

The initial permeability of polycrystalline yttrium iron garnet has been measured as a function of density at frequencies from 5 kc/sec to 7.5 gc/sec. The samples were prepared by grinding very pure single crystals into a powder and then pressing and sintering. The samples of highest density have 2 absorption peaks that occur at approximately 1 mc/sec and 200 mc/sec. This is in very good agreement with observations on polycrystalline samples prepared with coprecipated powders but not with those prepared with raw oxides. The separation between the 2 absorption peaks decreases as the sample density decreases, until ultimately only one peak is observed in a sample with 72% density. The results are interpreted in terms of the changing sample porosity.

1734

Minnesota U., Minneapolis.

MECHANISM OF SPIN-WAVE PINNING IN SOME FERROMAGNETIC FILMS, by C. W. Searle and A. H. Morrish. [1963] [2]p. (AFOSR-64-1247) (AF 49(636)-603) AD 442797   Unclassified

Also published in Phys. Ltrs., v. 7: 229-230, Dec. 1, 1963.

An experimental study of the influence that the boundary conditions of thin ferromagnetic films have on spin-wave spectra has been made.

1735

Minnesota U., Minneapolis.

ALTERATIONS OF BRAIN BIOCHEMISTRY AND DEVELOPMENT OF BEHAVIOR, by F. E. Shideman. [1964] [9]p. incl. tables. (AFOSR-64-1276) (AF AFOSR-63-204) AD 602765   Unclassified

These studies were undertaken to provide a basis for future experiments in which the catecholamine and/or serotonin of the brain would be altered at various stages of embryonic and neonatal development and the influence of such changes on subsequent development of certain types of behavior determined. Infant rats were killed at different times after birth. There appear to be two periods in the young developing rat at which rather abrupt increases in total catecholamine concentration occur. The first of these is at some time between 1 1/2 and 4 days after birth and the second when the animal is 24 to 26 days of age. At the latter time, concentrations of brain serotonin are more than twice those found in the newly born animal.

1736

Minnesota U. Dept. of Aeronautics and Engineering Mechanics, Minneapolis.

THE EFFECT OF HIGH-FREQUENCY SUPPORT

OSCILLATION ON THE MOTION OF A SPHERICAL
PENDULUM, by G. W. Hemp and P. R. Sethna. [1964]
[4]p. incl. diagrs. refs. (AFOSR-64-2315)
(AF AFOSR-62-275) AD 452303   Unclassified

Also published in Jour. Appl. Mech., June 1964,
p. 351-354.

This investigation studies the problem of a spherical
pendulum with a vertically oscillating point of suspen-
sion. The study will be made for arbitrary angular
displacements of the pendulum, but certain assump-
tions will be made with regard to the amplitude and
frequency of the support motion.

1737

Minnesota U. [Dept. of Electrical Engineering]
    Minneapolis.

WAVEGUIDE PERTURBATION TECHNIQUES IN MI-
CROWAVE SEMICONDUCTOR DIAGNOSTICS, by
K. S. Champlin and D. B. Armstrong. [1963] [5]p.
(AFOSR-J1113) (AF 49(638)747) AD 422966
                        Unclassified

Also published in IEEE Trans. Microwave Theory and
Tech., v. MTT-11: 73-77, Jan. 1963.

In studying detailed scattering mechanisms, a micro-
wave transport experiment contains potentially more
information than an analogous dc experiment. This
paper discusses perturbation techniques which are use-
ful in determining the microwave conductivity and low-
field Hall effect of a bulk semiconductor contained in a
waveguide from measurement of the properties of the
transmitted wave.

1738

Minnesota U. Dept. of Electrical Engineering,
    Minneapolis.

CHARGE CARRIER INERTIA IN SEMICONDUCTORS,
by K. S. Champlin and D. B. Armstrong. [1964]
[9]p. incl. diagrs. refs. (AFOSR-64-1746) (AF 49-
(638)747 and AF AFOSR-64-606) AD 448293
                        Unclassified

Also published in Proc. IEEE, v. 52: 677-685, June
1964.

The conduction process in semiconductors exhibits ef-
fects associated with inertia of the carriers when the
observation frequency is comparable to the reciprocal
of the relaxation time for randomization of momenta.
This paper derives equivalent circuits which illustrate
inertial effects and discusses their temperature de-
pendence. A highly accurate reflection bridge tech-
nique for measuring microwave conductivity and per-
mittivity is then described. Finally, measurements
of conductivity and permittivity of n-type silicon and
p-type germanium at 24 Gc and at temperatures be-
tween 77° and 300°K are presented and compared

with theory. At 77°, the inertial effects are found to
be largest for the p-type germanium and cause the mi-
crowave conductivity to be less than the dc conductivity
by a factor of 1/2.

1739

Minnesota U. [Dept. of Electrical Engineering]
    Minneapolis.

THE MOBILITY AND RECOMBINATION OF POSITIVE
RARE GAS IONS, by V. R. Mittelstadt, J. M. Madison,
and R. J. Oskam. Final rept. Jan. 1963, 49p.
(AFOSR-4839) (AF AFOSR-62-103) AD 415615
                        Unclassified

This report describes briefly (1) a microwave system
for measuring the electron density in decaying plasmas
over t density range of about five thousand, (2) an ex-
perimental tube for measuring the value of the mobility
of positive ions by means of the transit-time method,
and (3) the results obtained during the period of the
contract. The studies were confined to the rare gas ions
and excellent agreement was found between the value of
the mobility of atomic and molecular ions as deter-
mined from ambipolar diffusion coefficient measure-
ments and those found by means of the ion transit-
time method. The influence of the presence of negative
ions on the ambipolar diffusion coefficient of electrons
was demonstrated.

1740

Minnesota U. Dept. of Electrical Engineering,
    Minneapolis.

ION MOBILITIES IN HELIUM, NEON, AND ARGON,
by H. J. Oskam and V. R. Mittelstadt. [1963] [10]p.
incl. diagrs. refs. (AFOSR-64-0810) (AF AFOSR-
62-103) AD 438376   Unclassified

Also published in Phys. Rev., v. 132: 1435-1444,
Nov. 15, 1963.

Measurements of the electron density as a function of
time during the decay period of pulsed plasmas pro-
duced in helium, neon, and argon are reported. The
values of the mobilities of positive ions in their parent
gas, calculated from the rate of electron loss by am-
bipolar diffusion are compared with those measured
with the ion-transit-time methods. The dependence on
gas pressure of the efficiency of the cataphoretic segre-
gation of neon impurity atoms in helium is demonstrat-
ed and explained. (Contractor's abstract)

1741

Minnesota U. Dept. of Electrical Engineering,
    Minneapolis.

MICROWAVE TECHNIQUES IN THE STUDY OF SEMI-
CONDUCTORS, by K. S Champlin and J. N. Bhar.
[1964] [1]p. (AFOSR-65-0187) (AF AFOSR-64-606)
AD 456559   Unclassified

Also published in Proc. IEEE, v. 52: Oct. 1964.

Bhar comments on the issue—taken by K. S. Champlin with 3 points raised in an earlier paper by Bhar (Proc. IEEE, v. 51: 1623-1631, Nov. 1963) concerning microwave conductivity and permittivity of semiconductors. These concern: (1) whether or not the relaxation time is velocity dependent; (2) a factor of 5 discrepancy in an early work by Benedict and Shockley (Phys. Rev., v. 89: 1152-1153, Mar. 1953); and (3) comparison of conductivities at microwaves and d.c.

1742

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

COMMENT ON "MICROWAVE MEASUREMENT OF CONDUCTIVITY AND DIELECTRIC CONSTANT OF SEMICONDUCTORS," by K. S. Champlin and B. R. Nag. [1964] [2]p. incl. diagr. (AFOSR-65-0188) (AF AFOSR-64-606) AD 456560　　　Unclassified

Also published in Proc. IEEE, v. 52: 1061-1062, Sept. 1964.

Theoretical sources of error are indicated in the expressions for determining the conductivity and dielectric constant of a thin semiconductor sample placed in the center of a rectangular waveguide. On checking experimental results, however, no error was found. Therefore, the accuracy of the method should be judged by using samples of different conductivities and dimensions, and calculating the actual contribution of all sources of error to the semiconductor parameters.

1743

Minnesota U. [Dept. of Mathematics] Minneapolis.

[A SYSTEM OF AXIOMS FOR EUCLIDEAN GEOMETRY] Ein Axiomensystem für die euklidische Geometrie, by H. Guggenheimer. [1964] [6]p. (AFOSR-65-1036) (AF AFOSR-62-93) AD 619766
Unclassified

Also published in Elemente Math., v. 19: 126-131, 1964.

A system of axioms is presented for Euclidean geometry. The axioms essentially state that there are no colinear points, that the plane is complete, and that the Pythagorean theorem is valid. The advantage of the system is the the fundamental relations contain only even powers or lengths, but that nevertheless directed line segments can be established in a natural way.

1744

Minnesota U. [Dept. of Mathematics] Minneapolis.

A NOTE ON THE MAP $H^1(X, G_\omega) \rightarrow H^1(X, G_c)$ FOR

CERTAIN COMPLEX MANIFOLDS, by H. Rohrl. [1963] [6]p. (AFOSR-J1586) (AF AFOSR-62-106) AD 427595　　　Unclassified

Also published in Topology, v. 2: 247-252, 1963.

For X, a holomorphically complete complex space, the canonical map A is a bijective. However, for complex spaces other than holomorphically complete ones information concerning the map A is scarce. It suggests itself to investigate this map for projective algebraic manifolds. Obviously A is surjective for X the Riemannian sphere and G the general linear group but A fails to be injective in this case. Surjectivity of A for x any compact Riemann surface and G any connected complex Lie group is proved. More generally it is shown that, given the holomorphic family of compact Riemann surfaces, the family of topological fiber bundles (with structure group a connected complex Lie group and fiber a complex space) is over a sufficiently small neighborhood U of each point of M topologically isomorphic to a holomorphic family of holomorphic fiber bundles.

1745

Minnesota U. [Dept. of Mathematics] Minneapolis.

[FUNCTIONAL ANALYSIS AND STOCHASTIC PROCESSES], by R. H. Cameron, G. E. Baxter and others. Final status rept. June 1, 1962-June 1, 1963, 5p. (AFOSR-5277) (AF AFOSR-62-252) AD 417491
Unclassified

A number of problems in Functional Analysis, Integration in Function Space, Stochastic Processes and related areas have been studied and several papers have been written.

1746

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON FUNCTIONS THAT COMMUTE WITH FULL FUNCTIONS, by G. Baxter and J. T. Joichl. [1964] [7]p. (AFOSR-64-1624) (AF AFOSR-62-252) AD 446880
Unclassified

Also published in Nieuw Archief voor Wiskunde, v. 12: 12-18, 1964.

Definition. A function f is a hat function if for some integer is greater than or equal to 1, f alternately takes on the values 0 and 1 at the points i/n, $1 = 0, 1, \ldots, n$, ($f(0) = 0$ or 1) and is linear in between. It is shown that any function g which commutes with a hat function f with n greater than or equal to 2, is either a constant or a hat function. It is shown that any function g which is nowhere constant and has only a finite number of maxima and minima and commutes with a full function f with n greater than or equal to 2 branches is necessarily itself a full function.

1747

Minnesota U. [Dept.] of Mathematics, Minneapolis.

THE BEHAVIOR OF INCREASING STABLE PROC-
ESSES FOR BOTH SMALL AND LARGE TIMES, by B.
Fristedt. [1964] [8]p. (AFOSR-65-2642) (AF AFOSR-
62-252) AD 627770   Unclassified

Also published in Jour. Math. and Mech., v. 13: 849-
856, Sept. 1964.

This paper is concerned with the sample functions of
increasing stable processes having no deterministic
linear component.

1748

Minnesota U. [Dept. of Mathematics] Minneapolis.

SUPER-SOLUTIONS FOR QUASI-LINEAR ELLIPTIC
EQUATIONS, by H. Jenkins. [1963] [9]p. (AFOSR-
64-2324) (AF AFOSR-63-372) AD 452305
                                    Unclassified

Also published in Arch. Rational Mech. and Anal., v.
16: 402-410, 1963.

This paper gives a geometric characterization of su-
per-solutions in terms of the function E. This charac-
terization is then applied to construct explicit families
of super-solutions, which are in turn used to deduce
theorems about the behavior of solutions.

1749

Minnesota U. [Dept. of Mathematics] Minneapolis.

RATIO LIMIT THEOREMS FOR MARKOV CHAINS, by
J. F. C. Kingman and S. Orey. [1964] [4]p. (AFOSR-
65-0868) (AF AFOSR-63-380) AD 617586
                                    Unclassified

Also published in Proc. Amer. Math. Soc., v. 15:
907-910, Dec. 1964.

This note considers Markov chains with stationary tran-
sition probabilities and state space $S = 0, 1, 2, \ldots$, in
both discrete and continuous time. When (1)

$$\lim_{n \to \infty} \frac{P_{ij}^{(n+m)}}{P_{kh}^{(n)}} = \frac{\pi_j}{\pi_h}, \quad m = 0, \pm 1, \pm 2, \ldots, i, j, k, h$$

S, it is said that the strong ratio limit property S
(SRLP) holds. In the continuous time case (1) is re-

placed by (2) $\lim_{t \to \infty} \dfrac{P_{ij}^{(t + \Delta)}}{P_{kh}^{(t)}} = \dfrac{\pi_j}{\pi_h}, \; -\infty < \Delta < \infty, \; i, j,$

k, h S. It is shown that if the probability of returning
to i by time N is greater than ϵ, where N and ϵ are
positive numbers independent of i, SRLP holds. The
condition can be taken as a weak form of spatial homo-
geneity. Since (1) and (2) may not hold, substitutes for
SRLP are further discussed.

1750

Minnesota U. [Dept. of Mathematics] Minneapolis.

CONSTRUCTION OF A MARKOV PROCESS FROM HIT-
TING PROBABILITIES, by F. Knight and S. Orey.
[1964] [17]p. (AFOSR-65-0869) (AF AFOSR-63-380)
AD 617625   Unclassified

Also published in Jour. Math. and Mech., v. 13: 857-
873, Sept. 1964.

In this note it is shown that there exists a Markov
process with stationary transition probabilities having
the $H_A(x, .)$ as hitting probabilities and such that a func-
tion g(x) is the expected lifetime of the process when
started at x. Argumentation leads to a final theorem
containing the expected lifetime, the hitting probabili-
ties, and the transition probabilities of the Markov
process X_x^∞.

1751

Minnesota U. [Dept. of Mathematics] Minneapolis.

EIGENVALUES OF NON-NEGATIVE MATRICES, by
W. E. Pruitt. [1964] [4]p. (AFOSR-65-0870)
(AF AFOSR-63-380) AD 617587   Unclassified

Also published in Ann. Math. Stat., v. 35: 1797-1800,
Dec. 1964.

If $P = (pij)$, $i, j, = 0.1, 2, \ldots$, is a matrix with non-neg-
ative entries, it is said to be irreducible if for every
pair i, j, there is a finite sequence of integers k_1,
$k_2, \ldots, k_n$ such that $p_{ik_1} p_{k_1 k_2} \cdots p_{k_n j} > 0$. This note
considers such an irreducible matrix as an operator
acting on column vectors having non-negative entries.
A necessary and sufficient condition for there to be a
solution of $px = \lambda x$ is obtained. P is transformed into a
substochastic matrix to which the Harris-Veech theo-
rem is applied, which gives a necessary and sufficient
condition for the existence of a stationary measure for
a transient Markov chain. R-recurrent and recurrent
matrices are investigated and related in the stochastic
case to the given eigenvalue problem.

1752

Minnesota U. Dept. of Mathematics, Minneapolis.

ON THE LIMIT BEHAVIOUR OF EXTREME ORDER
STATISTICS, by O. Barndorff-Nielsen. Mar. 6, 1963,
22p. incl. refs. (AFOSR-5525) (AF AFOSR-63-381)
                                    Unclassified

This paper is concerned with some recent developments
in the theory of limit behavior of extreme order sta-
tistics. Section 1 introduces notations and definitions
and states a few elementary facts concerning the dis-
tributions of the set of order statistics corresponding
to a set of independent, identically distributed random
variables. Section 2 deals with limit distributions,
while sections 3 and 4 deal with stability in probability

and stability almost surely. Section 5 turns to the dependence case, summarizing some recent results. Section 4 contains a proof of the sufficiency of a simple condition for stability almost surely of the maximal order statistic.

1753

[Minnesota U. Dept. of Mathematics, Minneapolis]

SUBFIELDS AND LOSS OF INFORMATION, by O. Barndorff-Nielsen. [1964] [11]p. (AFOSR-64-2279) (AF AFOSR-63-381) AD 452373   Unclassified

Also published in Zeitschr. Wahrscheinlichkeits-theorie, v. 2: 369-379, 1964.

This paper is a study of a minimax-type measure of the loss of information occurring from observing only a sub-field of the sigma field describing a given experiment. In order not to obscure the ideas behind the definition and basic properties of the loss measure by technical difficulties of a mathematical nature, the simple framework of finite-atomic sigma fields was chosen for discussion. Generalizations and further results will be given in a subsequent paper.

1754

Minnesota U. [Dept. of Mathematics] Minneapolis.

ASYMPTOTIC BEHAVIOR OF SUCCESSIVE ITERATES OF CONTINUOUS FUNCTIONS UNDER A MARKOV OPERATOR, by B. Jamison. [1964] [12]p. incl. refs. (AFOSR-65-2624) (AF AFOSR-63-381) AD 628438
                                        Unclassified

Also published in Jour. Math. Anal. and Appl., v. 9: 203-214, Oct. 1964.

Let $P(x, E)$ be a transition probability operator on a compact metric state space S. This paper studies the asymptotic behavior of the sequences $\{\int f(y)P^n(\cdot, dy)\}$ for continuous functions f on S. In section 2, it is shown that if $P(x, E)$ is "uniformly stable in mean" then the Cesaro averages of the sequences in question converge uniformly to constants if and only if there are not two disjoint invold topologically and stochastically closed subsets in S. In Section 3, a stronger condition is imposed on called "uniform stability", and several conditions are given necessary and sufficient for the uniform convergence of the sequences themselves to constants. In Section 4, two applications are given.

1755

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON A CLASS OF COMMUTING FUNCTIONS, by G. Baxter and J. T. Joichi. [1964] [11]p. incl. diagrs. (AFOSR-65-2631) (AF AFOSR-63-381) AD 627980
                                        Unclassified

Also published in Nieuw Archief voor Wiskunde, v. 12: 126-136, 1964.

Let X be the unit interval (0, 1) and let F and G be a pair of functions mapping X continuously into itself, and which commute under composition, that is, $F(G(x)) = G(F(x))$. It has been conjectured that under these circumstances the functions F and G must have a common fixed point. This conjecture has only been verified in some very special cases. It appears to us that among the primary difficulties encountered in attempting to verify the conjecture in more general cases is the lack of a plentiful supply of examples to investigate. This paper introduces a method by which a variety of such pairs of functions may be constructed.

1756

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON PERMUTATIONS INDUCED BY COMMUTING FUNCTIONS, AND AN EMBEDDING QUESTION, by G. Baxter and J. T. Joichi. [1963] [11]p. (AFOSR-65-2632) (AF AFOSR-63-381) AD 627979   Unclassified

Also published in Math. Scand., v. 13: 140-150, 1963.

Let $f \equiv f(x)$ and $g \equiv g(x)$ be two continuous and commuting functions (under substitut n) each mapping the closed interval [a, b] into itself. Isbell has conjectured that f and g must have a common fixed point, or equivalently, that f and the composite function $h = fg \equiv f(g(x))$ must have a common fixed point. Except in special cases the conjecture has not been verified. This paper suggests one method for attacking the Isbell conjecture by trying to embed the commuting functions in a semigroup and thereby proving the existence of the common fixed point.

1757

[Minnesota U. Dept. of Mathematics, Minneapolis]

REMARKS ON THE EXTREME EIGENVALUES OF TOEPLITZ FORMS ASSOCIATED WITH ORTHOGONAL POLYNOMIALS, by S. V. Parter. Aug. 1964, 32p. (Rept. no. MRC-TSR-498) (AF AFOSR-63-381)
                                        Unclassified

The extreme eigenvalues of the truncated Toeplitz matrices associated with certain orthogonal polynomials were studied. In particular, certain comparison theorems enable one to extend the results of Hirschman for the classical orthogonal polynomials.

1758

Minnesota U. Heat Transfer Lab., Minneapolis.

EMISSIVITY MEASUREMENT OF POROUS MATERIALS, by O. E. Tewfik and Y.-W. Yang. [1963] [2]p. incl. diagrs. (AFOSR-3677) (AF 49(638)558) AD 430658   Unclassified

Also published in Jour. Heat Transfer, Feb. 1963, p. 79-80.

The pres ...ote describes a method by which the total hemispherical emissivity of a porous material is readily measured without the use of a radiometer or special sample preparation.

1759

Minnesota U. Heat Transfer Lab., Minneapolis.

ONE-DIMENSIONAL MASS AND HEAT TRANSFER AND THEIR COUPLING, by O. E. Tewfik. [1964] [13]p. incl. diagrs. (AFOSR-64-1878) (AF 49(638)558) AD 449983   Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 7: 409-421, 1964.

Consideration is given to the steady-state transfer of mass and heat from a porous wall to a non-dissipative binary system or air-hydrogen in one case, and air-carbon dioxide in another. Hydrogen or helium is injected at a uniform rate through the porous wall into the system. According to the thermodynamics of irreversible processes, the fluxes of heat and mass are coupled. The effects of such coupling are shown to be small on the concentration field, appreciable on the temperature field and heat flux under certain conditions, and negligible on the heat-transfer coefficient when defined in terms of an adiabatic wall temperature. In general, the magnitude of the effects are much more pronounced for hydrogen injection than for carbon dioxide injection. (Contractor's abstract, modified.

1760

Minnesota U. Heat Transfer Lab., Minneapolis.

DIFFUSION-THERMO EFFECTS IN STAGNATION-POINT FLOW OF AIR WITH INJECTION OF GASES OF VARIOUS MOLECULAR WEIGHTS INTO THE BOUNDARY LAYER, by E. M. Sparrow, W. J. Minkowycz, and E. R. G. Eckert. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-1023) (AF AFOSR-64-17) AD 440961   Unclassified

Also published in AIAA Jour., v. 2: 652-659, Apr. 1964.

This paper is concerned with the effect of diffusion thermo on the heat transfer, mass transfer, and flow in a boundary layer into which various foreign gases are injected. Air is the mainstream gas. Particular consideration is given to the question of how the magnitude of the diffusion-thermo effect is related to the molecular weight of the injected gas. Correspondingly the analysis includes injection of hydrogen, helium, argon, carbon dioxide, and xenon; the selection of these was also influenced by the availability of transport and thermodynamic properties. The study is carried out for plane and axisymmetric stagnation flow in forced convection and for plane stagnation flow in free convection. (Contractor's abstract, modified)

1761

Minnesota U. Heat Transfer Lab., Minneapolis.

RECENT STUDIES RELATING TO MASS TRANSFER COOLING, by E. M. Sparrow. [1964] [18]p. (AFOSR-64-1681) (AF AFOSR-64-17) AD 449995
                    Unclassified

Also published in Proc. Heat Transfer and Fluid Mechanics Inst., ed. by W. F. Giedt and S. Levy, Stanford U. Press, 1964, p. 1-18.

This paper is concerned with the effects of thermal diffusion and diffusion thermo on the heat transfer, mass transfer, and flow in a boundary layer into which various foreign gases are injected. Air is the main stream gas. One effect of diffusion thermo is to create an adiabatic wall temperature which differs from the main stream temperature Te. Under nonadiabatic conditions, the rate of heat transfer from (or to) the surface can be substantially altered by the diffusion-thermo effect when the ratio of wall to stream temperature is not greatly different from unity. Specific consideration is given to the heat transfer results for plane stagnation flow in forced convection and for the stagnation region of a horizontal cylinder in free convection.

1762

Minnesota U. Heat Transfer Lab., Minneapolis.

THE EFFECT OF DIFFUSION THERMO AND THERMAL DIFFUSION FOR HELIUM INJECTION INTO PLANE AND AXISYMMETRIC STAGNATION FLOW OF AIR, by E. M. Sparrow, W. J. Minkowycz and others. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-64-2247) (AF AFOSR-64-17) AD 452526   Unclassified

Presented at ASME-AIChe Heat Transfer Conference and Exhibit, Boston, Mass., Aug. 11-14, 1963.

Also published in Jour. Heat Transfer, Aug. 1964.

An analysis has been carried out with the aim of clarifying the effects of diffusion thermo and thermal diffusion on heat transfer, flow, and mass transfer for the helium-air boundary layer in stagnation flow. To provide information applicable to both laboratory-type situations and aerospace applications, results have been obtained over the range of free-stream temperatures from 500° to 5000°R. For ratios of wall-to-stream temperature (Tw/Te) which differ only moderately from unity, it is found that the aforementioned diffusional transport has a decisive effect on heat transfer. Further, the diffusion thermo is far more important than the thermal diffusion. (Contractor's abstract, modified)

1763

Minnesota U. Inst. of Tech., Minneapolis.

VARIATIONAL PROBLEMS OF MINIMAL SURFACE

TYPE. 1, by H. Jenkins and J. Serrin. [1963] [26]p.
(AFOSR-J1024) (AF AFOSR-62-101) AD 419669
Unclassified

Also published in Arch. Rational Mech. and Anal.,
v. 12: 185-212, 1963.

The solutions of a variational problem of minimal sur-
face type are known to share certain properties with
non-parametric minimal surfaces; for example, they
cannot have isolated singularities. Moreover, as is the
case with the classical minimal surface equation, there
can exist no non-linear entire solutions of a problem
of minimal surface type. There are established a num-
ber of further properties of solutions of variational
problems of minimal surface type. The results are
new, even in the classical minimal surface case, and
contrast sharply, as do the properties above, with
analogous results for solutions of uniformly elliptic
equations.

1764

Minnesota U. Inst. of Tech., Minneapolis.

[PROBLEMS IN HYDRODYNAMICS AND PARTIAL
DIFFERENTIAL EQUATIONS]. Final technical rept.
June 1, 1962-May 31, 1963, 4p. (AFOSR-J1443)
(AF AFOSR-62-101) Unclassified

The contents of this report are: (1) Variational calcu-
lus, (2) Linear and non-linear partial differential equa-
tions, and (3) Navier-Stokes equations.

1765

Minnesota U. School of Chemistry, Minneapolis.

EFFECT OF HETEROCONJUGATION ON ACID-BASE
CONDUCTOMETRIC TITRATION CURVES OF 3,5-
DINITROBENZOIC ACID IN ACETONITRILE, by I. M.
Kolthoff and M. K. Chantooni, Jr. [1963] [7]p. incl.
diagrs. tables, refs. (AFOSR-J1097) (AF 49(636)519)
AD 420660 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85:
2195-2201, Aug. 5, 1963.

Heteroconjugation is defined as the conjugation of an
anion A^- with a hydrogen bond donor HR: $A^- +$
$nHR \rightleftharpoons A(HR)_n^-$. In a solvent which is a non-hydrogen
bonder and has a dielectric constant of 40 or less, like
acetonitrile, the degree of dissociation of a salt
BH^+A^- is greatly increased by addition of HR. As a
result of heteroconjugation the maximum in conduc-
tance between 50 and 100% neutralization in the con-
ductometric titration with an amine of an incomplete-
ly dissociated acid HA, which has no intramolecular
hydrogen bonds, can be eliminated in the presence of
HR. Conductometric titration curves in acetonitrile
of sulfuric acid with pyridine in the presence of vari-
ous concentrations of resorcinol and of 3,5-dinitro-
benzoic acid with triethylamine in the presence of
resorcinol or p-bromophenol illustrate this effect of
heteroconjugation. The calculated conductances on the
titration curves of 3,5-dinitrobenzoic acid with tri-

ethylamine in the presence of various concentrations of
resorcinol were found to be in satisfactory agreement
with the experimental data. Infrared spectra of solu-
tions in acetonitrile of tetraethylammonium 3,5-dini-
trobenzoate in the presence of varying concentrations
of resorcinol or p-bromophenol substantiate the con-
clusion that heteroconjugation occurs by hydrogen
bonding. Structures for the various heteroconjugates
are postulated. (Contractor's abstract, modified)

1766

Minnesota U. School of Chemistry, Minneapolis.

THE REACTION OF VINYLMERCURIC IODIDE WITH
NONHALOGEN ACID, by M. M. Kreevey and R. A.
Kretchmer. [1964] [6]p. (AFOSR-64-1412) (AF 49-
(638)711) AD 445074 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86:
2435-2440, 1964.

The rate-determining step in the cleavage of vinyl-
mercuric iodide to ethylene and HgI^+ is the transfer of
a proton from a hydronium ion to carbon. The rate is
first order in substrate and roughly proportional to the
acid concentration up to about 4 M perchloric or sul-
furic acid. The solvent isotope effect is 2.96 ± 0.10 at
25°C in dilute perchloric acid. In 2.5 M sulfuric acid,
it is 2.2 ± 0.2. The enthalpy and entropy of activation
are 17.6 ± 0.4 kcal/mole and -16.5 ± 1.3 cal/mole/deg,
respectively. These results require that proton trans-
fer be rate determining and suggest a transition state
somewhat more highly solvated than the starting state.
It is further suggested that desolvation of the hydro-
nium ion lags seriously behind the actual proton
transfer.

1767

Minnesota U. [School] of Chemistry, Minneapolis.

STATISTICAL MECHANICS OF CROSS-LINKED POLY-
MERS: FORMATION OF THE INFINITE NETWORK, by
H. Brodowsky and S. Prager. [1963] [5]p. incl. diagr.
(AFOSR-4664) (AF 49(636)720) AD 408365
Unclassified

Also published in Jour. Chem. Phys., v. 39: 1103-
1107, Aug. 15, 1963.

It is shown that crosslinks of infinite functionality in
equilibrium with a solution of bifunctional monomer be-
have as particles interacting with a Debye-Huckel type
of potential. Applying the Debye-Huckel theory to a
fluid consisting of such particles leads to a condensa-
tion phenomenon which corresponds to gel formation.

1768

Minnesota U. [School of Chemistry] Minneapolis.

EFFECTIVE DIFFUSION COEFFICIENT IN POROUS

MEDIA, by H. L. Weissberg. [1963] [4]p. incl. diagr. (AFOSR-4684) (AF 49(638)720) AD 410160
Unclassified

Also published in Jour. Appl. Phys., v. 34: 2636-2639, Sept. 1963.

Recent calculations by Prager of upper bounds for the effective diffusion coefficient (or conductivity) in porous media, in terms of certain statistical parameters of the random geometry, are reformulated so as to apply specifically to a bed of spherical particles. The calculations are simplified by considering an idealized bed in which centers are randomly situated without restricting the spheres to nonoverlapping locations. The result, applicable to randomly overlapping spheres of either uniform or nonuniform sizes, gives the upper bound for the effective diffusion coefficient as $\Phi D_0/[1-1/2 \ln \Phi]$, where D_0 is the actual diffusion coefficient in a fluid which fills the void regions of the bed and Φ is the void fraction. This result is compared with experimental results of various investigators. (Contractor's abstract, modified)

1769

Minnesota U. [School] of Chemistry, Minneapolis.

BROWNIAN MOTION IN MANY-PARTICLE SYSTEMS. I. FORCED INTERDIFFUSION OF TWO SPECIES, by G. W. Woodbury, Jr., and S. Praeger. [1964] [5]p. incl. refs. (AFOSR-64-1948) (AF 49(638)720) AD 450514
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3417-3421, Sept. 5, 1964.

This paper discusses a system consisting of two species, alpha and beta whose molecules are subjected to opposing external forces A(a) and A(b), causing a to move relative to b with a mean velocity u. On the assumption that each molecule is undergoing a Brownian motion biased by the external forces and its interactions with other molecules, it is possible to derive a rigorously valid upper bound on the magnitude of u, a bound which can be expressed in terms of equilibrium two- and three-particle distribution functions. Explicit calculations are given for the case where the alpha-species is present at very low concentrations and the beta-molecules do not interact with one another. (Contractor's abstract)

1770

Minnesota U. School of Chemistry, Minneapolis.

PERTURBATION THEORY AND THE HELLMANN-FEYNMAN THEOREM, by R. Yaris. [1963] [5]p. (AFOSR-J1489) (AF 49(638)940) AD 427945
Unclassified

Also published in Jour. Chem. Phys., v. 39: 863-867, Aug. 15, 1963.

By using the Hellmann-Feynman theorem in conjunction with an operator formulation of perturbation

theory it is shown that, while for a general Hamiltonian an energy derivative is determined only to order n by an nth-order wave-function (Salem and Wilson), for a restricted class of systems it is determined to order $n+1$, and by restricting the class somewhat further one can obtain energy derivatives to order $2n+1$. The example of the force between two atoms interacting through dispersion type forces is briefly discussed.

1771

Minnesota U. [School of Chemistry] Minneapolis.

TIME-DEPENDENT PERTURBATION-VARIATION METHOD, by R. Yaris. [1963] [4]p. (AFOSR-64-0221) (AF 49(638)940) AD 432510
Unclassified

Also published in Jour. Chem. Phys., v. 39: 2474-2477, Nov. 1963.

Through the use of the time-ordered perturbation expansion, an operator equation for the time-dependent perturbation problem, of the same form as occurs in the time-independent problem, is generated. Thus, a variational method can be used to study the time-dependent case as well as the time-independent case. This variational method is used to recover the Dirac expansion as an example of a solution in series form, and it is also used to develop a simple (approximate) analytic solution as an example of a solution in closed form.

1772

Minnesota U. [School of Chemistry] Minneapolis.

RESOLVENT OPERATOR FORMULATION OF STATIONARY STATE PERTURBATION THEORY, by R. Yaris. [1964] [7]p. (AFOSR-64-1466) (AF 49(638)940) AD 445021
Unclassified

Also published in Jour. Chem. Phys., v. 40: 1891-1897, Apr. 1, 1964.

By starting with an exact operator equation and using different methods of expanding the resolvent operator, the Schrodinger, Wigner-Brilloin, similarity transformation, gauge transformation, and first-order perturbation iteration method, perturbation expansions are generated in a rigorous and straightforward manner. It is also shown how additional perturbation and perturbation iteration methods can be generated.

1773

Minnesota U. School of Chemistry, Minneapolis.

COMMENTS ON THE RESONANCE FLUORESCENCE IN GASES, by C. A. Mead and H. F. Hameka. [1964] [1]p. (AFOSR-65-0371) (AF 49(638)940) AD 611921
Unclassified

Also published in Jour. Chem. Phys., v. 40: 606, Jan. 15, 1964.

A new theoretical description of resonance fluorescence
has been developed and applied to dilute gases and mo-
lecular crystals. It was shown that all properties of
resonance fluorescence can be derived from a matrix,
which was called the damping matrix. The purpose of
the report is to make two comments on the treatment of
dilute gases.

1774

Minnesota U. [School] of Chemistry, Minneapolis.

POINT DEFECTS IN MAGNESIUM OXIDE, by J. E.
Wertz, G. S. Saville and others. [1963] [20]p. incl.
diagrs. (AFOSR-5519) (AF AFOSR-62-54)
Unclassified

Electron spin resonance has provided a means of de-
tecting numerous defect centers as well as of con-
structing models for them. A model involving next-
nearest-neighbor vacancy association has been proposed
for a titanium center. A center resulting from heating
MgO in hydrogen has been detected by its strong doub-
let absorption at 3300 cm^{-1}. Using the ESR spectrum
of F-centers to monitor their concentration through a
series of bleaching experiments, it has been possible
to assign the 5 ev optical absorption band to F-centers.
Marked resemblances of neutron-irradiated MgO
spectra with recent alkali halide F-aggregate spectra
are noted and discussed in relation to lattice vibration
frequencies. (Contractor's abstract)

1775

Minnesota U. School of Chemistry, Minneapolis.

POLAROGRAPHY IN ACETONITRILE OF TITANIUM
TETRACHLORIDE AND TETRAIODIDE IN VARIOUS
SUPPORTING ELECTROLYTES, by I. M. Kolthoff and
F. G. Thomas. [1964] [10]p. incl. diagrs. tables,
refs. [1964] [10]p. incl. diagrs. tables, refs.
(AFOSR-64-2202) (AF AFOSR-63-26) AD 452399
Unclassified

Also published in Jour. Electrochem. Soc., v. 111:
1065-1074, Sept. 1964.

Current-potential curves of titanium tetrachloride in
acetonitrile (AN) with tetraethylammonium perchlorate
as supporting electrolyte have been determined at the
dropping mercury electrode. The effect of chloride,
bromide, iodide, and thiocyanate ions has been inves-
tigated. In general, only two well defined reduction
waves were obtained. With tetraethylammonium chlor-
ide as supporting electrolyte, three reduction waves
corresponding to the reduction of Ti(IV) to Ti(III),
Ti(II), and Ti(0), were observed. Titanium tetraiodide
in AN with tetraethylammonium perchlorate as sup-
porting electrolyte gives a single reduction wave at the
dropping mercury electrode corresponding to the reduc-
tion of Ti(IV) to Ti(0). (Contractor's abstract,
modified)

1776

Minnesota U. School of Chemistry, Minneapolis.

REVIEW OF FUNDAMENTALS OF POLAROGRAPHY
IN INERT ORGANIC SOLVENTS, by L. M. Kolthoff.
[1964] [15]p. incl. tables, refs. (AFOSR-65-1652)
(AF AFOSR-63-26) AD 624330   Unclassified

Presented at Third Internat'l. Cong. of Polarography.

Also published in Jour. Polarog. Soc., v. 10: 22-36,
1964.

The fundamental aspects of polarography in non-aqueous
media are reviewed with special emphasis on inert, non-
protonating solvents. The interrelationship between
the potential scales in different solvents is considered,
in terms of the Pleskov and Strehlow conventions. The
polarography of cationic and anionic species in aceto-
nitrile is discussed in detail. Protonation reactions in
non-aqueous solvents is also considered in terms of the
acid-base characteristics of each system. Finally, a
detailed description is given of the polarography of
titanium halides in acetonitrile. (Contractor's abstract)

1777

Minnesota U. [School of Chemistry] Minneapolis.

NUCLEAR MAGNETISM, by J. E. Wertz. [1964] [14]p.
incl. refs. (AFOSR-65-1761) (AF AFOSR-63-200)
AD 625546   Unclassified

Also published in Magnetic Materials Digest, ed. by
A. H. Morrish, R. J. Prosen, and S. M. Rubens.
Philadelphia, M. W. Lads Publishing Co., 1964,
p. 241-254.

A review is presented of recent research on the effects
of interactions of nuclei with non-zero spin on mag-
netic systems. Subjects covered include nuclear mag-
netic resonance, nuclear spin-spin interactions, nu-
clear specific heats, hyperfine interaction measure-
ments and quadrupole effects, and hyperfine interaction
measurements on rare earth compounds.

1778

Minnesota U. [School] of Chemistry, Minneapolis.

POINT DEFECTS IN MAGNESIUM OXIDE, by J. E.
Wertz, G. S. Saville and others. [1964] [12]p. incl.
diagrs. refs. (AFOSR-65-1762) (AF AFOSR-63-200)
AD 625550   Unclassified

Also published in Proc. Brit. Ceram. Soc., July 1964,
59-70.

Electron spin resonance provides a means of detecting
numerous defect centers as well as a means of con-
structing models for them. A model involving next-
nearest-neighbor vacancy association is proposed for a
titanium center. A center resulting from heating MgO
in hydrogen has been detected by its strong doublet
absorption at 3300 cm^{-1}. Using the esr spectrum of F

centers to monitor their concentration through a series of bleaching experiments, it has been possible to assign the 5 ev optical absorption band to F centers. Marked resemblances of neutron-irradiated MgO spectra with recent alkali halide F aggregate spectra are noted and discussed in relation to lattice vibration frequencies. (Contractor's abstract, modified)

1779

Mississippi U. Dept. of Chemistry, University.

DETERMINATION OF SPECTROSCOPIC AND THERMO-DYNAMIC CONSTANTS FOR A SYSTEM OF 1:1 AND 2:1 COMPLEX EQUILIBRIUM REACTIONS, by N. B. Jurinski. [1964] [7]p. (AFOSR-4954) (AF AFOSR-62-19) AD 413760   Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10: 74-81, 1964.

A method of determining the formation constants and the molar absorbancy indices of several complex systems is described. It is shown that observed variations in the apparent formation constant with wavelength or concentration (based on the assumption of only 1:1 interactions) may be attributable to consecutive or simultaneous formation of higher order complexes. (Contractor's abstract)

1780

Mississippi U. Dept. of Chemistry, University.

A QUANTITATIVE SPECTROPHOTOMETRIC STUDY OF INTERACTIONS BETWEEN IODINE AND ARYL METHYL SULFIDES IN CARBON TETRACHLORIDE, by V. Ramakrishnan and P. A. D. de Maine. [1963] 19p. incl. tables, refs. (AFOSR-4955) (AF AFOSR-62-19) AD 413759   Unclassified

Mixtures of aryl methyl sulfides and iodine in carbon tetrachloride have two charge-transfer absorption bands with maxima located near 3050 A and between 3380 and 3525 A, respectively. Computer analysis of spectrophotometric data for these systems at 20° and 45°C has shown that (1) data collected between 3300 and 3600 A are consistent with the simultaneous reversible formation of two isomeric 1:1 complexes between the sulfide and iodine, and (2) data between 2900 and 3100 A (the region where the sulfides absorb) cannot be explained by the simultaneous reversible formation of two isomeric 1:1 complexes. Thermodynamic and spectroscopic constants for the iodine complexes with thioanisole and with o-, m-, and p-tolyl methyl sulfides in carbon tetrachloride are given. Contact charge-transfer and charge-transfer theories are considered. (Contractor's abstract)

1781

Mississippi U. Dept. of Chemistry, University.

TEMPERATURE CONTROL ATTACHMENTS FOR VARIABLE AND FIXED PATH LENGTH INFRARED

CELLS, by M. S. Smith and P. A. D. de Maine. [1963] [3]p. incl. diagr. (AFOSR-J282) (AF AFOSR-62-19) AD 400877   Unclassified

Also published in Canad. Jour. Chem., v. 41: 812-814, 1963.

Quantitative studies of the temperature dependence of infrared spectra for liquids have been frustrated by the difficulties in designing adequate devices for controlling the liquid temperature in the cells. This paper describes an inexpensive attachment for controlling the sample temperature in ordinary infrared cells.

1782

Mississippi U. [Dept. of Chemistry] University.

THE INTERACTION OF IODINE WITH ARYL METHYL SULFIDES, by V. Ramakrishnan. [1963] [4]p. (AFOSR-64-0131) (AF AFOSR-62-19) AD 431077
                                    Unclassified

Also published in Jour. Molec. Spectros., v. 11: 253-256, Oct. 1963.

Electronic spectral data for mixtures of iodine and aryl methyl sulfides in CCl_4 are reported. The mixtures exhibit two bands in the 290-360 mμ region, and under certain conditions a third band in the visible region. The two ultraviolet bands are attributed to the charge-transfer transition involving the two elg non-degenerate orbitals into which the elg orbital of benzene splits in unsymmetrically substituted benzenes. The intense color change which accompanies increased donor concentrations is explained by postulating the formation of an iodosulfonium ion.

1783

Mississippi U. [Dept. of Chemistry] University.

SPECTROPHOTOMETRIC AND NON-SPECTROPHO-TOMETRIC STUDIES OF SOLUTIONS, by P. A. D. de Maine. Summary rept. 1964, 8p. (AFOSR-64-1109) (AF AFOSR-62-19) AD 601692   Unclassified

Summaries are given of researches in the following areas: cryoscopic studies; theoretical projects; spectral studies of systems containing phosphonitrilic chlorides; complex formation between aromatic hydrocarbons and some nitro compounds solvent effects on charge-transfer complexes between 1,3,5-trinitrobenzene and aromatic hydrocarbons in different solvents; spectrophotometric study of interactions between iodine and aryl methyl sulfides in carbon tetrachloride; infrared spectral studies of complex formation; molecular interactions studied by means of precision dielectric constant measurements; conductance and viscosity studies of rare earth chlorides; and computer methods.

1784

Mississippi U. Dept. of Chemistry, University.

ULTRAVIOLET ABSORPTION SPECTRA OF

1, 3, 5-TRINITROBENZENE IN CARBON TETRA-
CHLORIDE, n-HEXANE, n-HEPTANE, CYCLOHEX-
ANE, OR CHLOROFORM, by C. C. Thompson, Jr.
and P. A. D. de Maine. [1964] [14]p. incl. tables.
(AFOSR-64-2184) (AF AFOSR-62-19) AD 452304
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10:
123-136, 1964.

Absorptivities of 1, 3, 5-trinitrobenzene dissolved in
five inert solvents (CCl_4, n-hexane, n-heptane, cyclo-
hexane, or $CHCl_3$) were calculated from spectropho-
tometric data collected at 50 A intervals between 2650
and 4300 A at 20° and 45°C. Deviations from Beer's
Law and temperature effects are discussed in terms of
interactions between two forms of the trinitrobenzene
molecule. At wavelengths below 3900 A, variations
in the trinitrobenzene abso. ptivity with solvent are
observed. (Contractor's abstract)

1785

Mississippi U. Dept. of Chemistry, University.

CHARGE-TRANSFER COMPLEX FORMATION BE-
TWEEN IODINE AND ARYL METHYL SULFIDES IN
CARBON TETRACHLORIDE, by V. Ramakrishnan
and P. A. D. de Maine. [1964] [14]p. incl. tables,
refs. (AFOSR-64-2185) (AF AFOSR-62-19)
AD 451922   Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10:
82-95, 1964.

For abstract see AFOSR-4955; Item no. 1780, Vol. 7.

1786

Mississippi U. Dept. of Chemistry, University.

CHARGE-TRANSFER COMPLEXES OF 1, 3, 5-TRINI-
TROBENZENE WITH HEXAMETHYLBENZENE, PEN-
TAMETHYLBENZENE, DURENE, MESITYLENE, OR
BENZENE, by C. C. Thompson, Jr. and P. A. D.
de Maine. [1964] [22]p. incl. tables, refs. (AFOSR-
64-2186) (AF AFOSR-62-19) AD 452031
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10:
137-158, 1964.

Here are reported formation constants and absorptivi-
ties of 1:1 complexes of 1, 3, 5-trinitrobenzene with
hexamethylbenzene, pentamethylbenzene, durene,
mesitylene or benzene dissolved in five inert solvents
(CCl_4, hexane, heptane, cyclohexane or $CHCl_3$).

Ultraviolet absorption data for these systems were
collected at 12 or 13 wavelengths between 2750 and
4200 A at 20° and 45°C. All data were processed with
an IBM 1620-60K digital computer using recently de-
veloped computer programs. Variations in the forma-
tion constants with wavelength have been attributed to
simultaneous 1:1 and higher order reactions.

1787

Mississippi U. [Dept. of Chemistry] University.

COMPLEX FORMATION BETWEEN AROMATIC HY-
DROCARBONS AND SOME NITRO COMPOUNDS, by
N. B. Jurinski and P. A. D. de Maine. [1964] [27]p.
incl. tables, refs. (AFOSR-64-2187) (AF AFOSR-
62-19) AD 452032   Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10:
96-122, 1964.

Analysis of ultraviolet spectral data for 1:1 complex
formation has yielded values of the association con-
stants, molar absorptivities of the complexes, and the
maximum permitted errors in these quantities, through
use of a new computer method. Values are listed at
20° and 45°C. over the wavelength range 300-400 mμ
for various nitrobenzene acceptors with a series of
methyl benzene donors. (Contractor's abstract)

1788

Mississippi U. Dept. of Chemistry, University.

CRYOSCOPIC EVIDENCE OF COMPLEX FORMATION
WITH $(PNCl_2)_3$ AND $(PNCl_2)_4$, by P. A. D. de Maine
and R. D. Srivastava. [1964] [7]p. incl. tables, refs.
(AFOSR-64-2188) (AF AFOSR-62-19) AD 452033
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10:
67-73, 1964.

Suppression constants are reported for $(PNCl_2)_3$,
$(PNCl_2)_4$ and naphthalene in cyclohexane; and for
chloranil and naphthalene in p-dioxane. Formation
constants (in mole fraction units) calculated from cryo-
scopic data for the 1:1 complexes, naphthalene-
$(PNCl_2)_3$ and naphthalene-$(PNCl_2)_4$ are 2.38 (± 0.60)
and 1.75 (± 0.25), respectively near 5°C. For the
naphthalene-chloranil complex in p-dioxane, the for-
mation constant (mole fraction units) is 5.2 (± 0.65)
near 8°C. (Contractor's abstract)

1789

Mississippi U. Dept. of Chemistry, University.

IODINE COMPLEXES IN INERT SOLVENTS. XVI.
QUANTITATIVE CRYOSCOPIC AND SPECTROPHOTO-
METRIC STUDIES OF SOME IODINE CHARGE-TRANS-
FER COMPLEXES, by R. D. Srivastava and P. A. D.
de Maine. [1964] [16]p. incl. tables, refs. (AFOSR-
64-2189) (AF AFOSR-62-19) AD 452030
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10:
51-66, 1964.

Cryoscopic and spectrophotometric studies of the naph-
thalene-iodine and diethyl ether-iodine one:one

charge-transfer complexes in bromoform and in ethylene bromide are reported. The results indicate that (1) weak charge-transfer complexes are formed because of specific interactions between individual donor and iodine molecules; (2) spectrophotometric methods can be used to determine thermodynamic constants for weak complexes; and (3) the inert solvent used determines the magnitude of the formation constant, but does not affect the heat of formation of the complex. (Contractor's abstract)

1790

Mississippi U. [Dept. of Chemistry] University.

CHARGE-TRANSFER COMPLEXES IN SOLUTION. I. SPECTROPHOTOMETRIC STUDIES OF AROMATIC HYDROCARBON-AROMATIC NITRO COMPOUNDS DISSOLVED IN CARBON TETRACHLORIDE, by N. B. Jurinski and P. A. D. de Maine. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-2210) (AF AFOSR-62-19) AD 452476   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3217-3222, Aug. 20, 1964.

This paper reports on an ultraviolet absorption spectral study of the charge-transfer complexes formed between certain methylbenzenes and selected aromatic nitro compounds in carbon tetrachloride at 20° and 45°C. Toluene, m-xylene, mesitylene, durene, pentamethylbenzene, and hexamethylbenzene were the donors used. Acceptors were nitrobenzene, m-dinitrobenzene, p-dimitrobenzene, sym-trinitrobenzene, and sym-trinitrotoluene. The new computer method designed to eliminate ambiguities from the literature was used to process all experimental information. For a given donor, the absorptivity of the complex (ac) increases as the strength of the acceptor is increased by increasing the number of nitro groups. (Contractor's abstract, modified)

1791

Missouri U. [Dept. of Mathematics] Columbia.

COMPLETELY WELL-POSED PROBLEMS FOR NON-LINEAR DIFFERENTIAL EQUATIONS, by M. D. George. [1964] [5]p. (AFOSR-3878) (AF AFOSR-62-97) AD 440974   Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 96-100, Feb. 1964.

A study is made of the effect on a completely well-posed problem of a nonlinear perturbation of the operator L. It is shown that under certain conditions a completely well-posed porblem for a differential operator L remains completely well-posed for L + A, where A is a nonlinear transformation in X. Combin-

ing this result with certain functional analysis conditions guaranteeing the existence of completely well-posed problems for perturbed differential operators can be derived. One such result is given for the case $X = L^2$.

1792

Missouri U. [Dept. of Mathematics] Columbia.

PERIODICITY AND BOUNDEDNESS OF SOLUTIONS OF GENERALIZED DIFFERENTIAL EQUATIONS OF GROWTH, by W. R. Utz and P. E. Waltman. [1963] [24]p. incl. refs. (AFOSR-J749) (AF AFOSR-62-207) AD 413643   Unclassified

Also published in Bull. Math. Biophys., v. 25: 75-93, 1963.

Sufficient conditions are given for the existence of periodic solutions of differential equations having as special cases the equations used to describe the competition between two species. Conditions implying the boundedness of solutions are also given. Integrable classes are provided and a particular example is examined in detail. (Contractor's abstract)

1793

Montana State U. Communication Research Lab., Missoula.

AN EXPERIMENTAL TECHNIQUE FOR THE STUDY OF HUMAN COMMUNICATION, by F. L. Brissey. Sept. 1964, 73p. incl. illus. tables, refs. (AFOSR-64-2409) (AF AFOSR-62-214) AD 609946   Unclassified

Results are reported of empirical studies of conditions assumed to influence the effectiveness of communication systems.

1794

Montreal U. Inst. of Experimental Medicine and Surgery (Canada).

THE DOCUMENTATION SERVICE OF THE INSTITUTE OF EXPERIMENTAL MEDICINE AND SURGERY OF THE UNIVERSITY OF MONTREAL, by G. Ember and G. Gabbiani. [1963] [4]p. (AFOSR-64-0683) (AF AFOSR-62-356) AD 436517   Unclassified

Also published in Bull. A. I. D., 1963, p. 19-22.

The system (SSS) of evaluating, storing and retrieving medical information at the Institute of Experimental Medicine and Surgery of the University of Montreal is described.

1795

Naples U. [Inst. of Aerodynamics] (Italy).

GENERALIZED VELOCITY POTENTIAL EQUATION
FOR PLURI-REACTING MIXTURES, by L. G.
Napolitano. Aug. 1963, 52p. (IA rept. no. 103)
(AFOSR-64-0885) (AF 61(052)327) AD 600098
Unclassified

The paper is concerned with the derivation and discussion of the velocity potential equation for steady linearized motions of gas mixtures in which any number k of independent reactions take place. In a first part a number of thermodynamic notions, of interest in the subsequent development of the analysis, are briefly recalled. The second part deals with the derivation of the generalized potential equation and with the analysis of its essential features. In a last part the limiting forms assumed by the potential equation when a number of reactions can be considered either frozen or in equilibrium are derived and discussed. Explicit expressions of the potential equation and of all other pertinent quantities for indicative cases of plane motions are listed in an appendix.

1796

Naples U. Inst. of Aerodynamics (Italy).

RESEARCH ON SUPERSONIC FLOW AROUND THREE
DIMENSIONAL POINTED BODIES, by L. G. Napolitano.
Final rept. Dec. 1964, 75p. incl. refs. (IA rept. no.
121) (AFOSR-65-1710) (AF 61(052)327) AD 625870
Unclassified

A review of research on non-equilibrium flows is presented. The work is divided into two parts, containing published and unpublished research, respectively. Part I deals with the thermodynamics and dynamics of multireacting mixtures. By starting from basic postulates, a self-consistent and complete thermodynamic theory is formulated. The study of the dynamics is mostly limited to the linearized approximation and falls within two categories: (a) formulation of basic equations and analysis of their overall properties; and (b) the solutions of typically representative flow fields. Part II deals with the derivation and discussion of the potential equation for linearized steady motion of a multireacting mixture within the volume-viscosity analogy. Also, the notion of thermodynamic characteristic speeds introduced in Part I is generalized, and a more exhaustive study of its properties is made.

1797

Naples U. Inst. of Theoretical Physics (Italy).

INEQUIVALENT REPRESENTATIONS AND SUPER-
CONDUCTIVITY, by L. Laplae and H. Umezawa.
[1964] [25]p. incl. diagr. (AFOSR-65-0744)
(AF EOAR-62-104) AD 315693   Unclassified

Also published in Nuovo Cimento, Series X, v. 33:
372-396, July 16, 1964.

The problem of superconductivity is considered from the viewpoint of the theory of the inequivalent representations for the quantized field. This theory naturally leads to the conclusion that the ground state is not an eigenstate of the number of electrons. This conclusion is independent of the assumption of the pair effects, although the final results given are the same as those of the B. C. S. theory. It is shown that the quantization of the magnetic flux can also be explained by the viewpoint presented. The method of the computation for higher-order effects is also briefly discussed.

1798

Naples U. Inst. of Theoretical Physics (Italy).

OBSERVATIONS ON SPIKE SEQUENCES FROM SPON-
TANEOUSLY ACTIVE PURKINJE CELLS IN THE
FROG, by V. Braitenberg. Final scientific rept.
Nov. 20, 1964 [35]p. incl. diagrs. table, refs.
(AFOSR-65-1488) (AF EOAR-63-89) AD 623799
Unclassified

A microelectrode whose tip is inserted in some portion of the nervous system in the vicinity of a neural cell body, which is either spontaneously active, or active under some stimulation, will record a sequence of pulses of fairly uniform shape and amplitude (spikes), separated by time intervals which in general vary in an apparently haphazard way. If the activity so recorded is interpreted as a message transmitted from neuron to neuron, at least 3 different analogies with types of messages as they occur in familiar physical situations may be proposed. More than one of these principles may be active conjointly, or different types of messages may be produced at different times by the same neuron.

1799

National Bureau of Standards, Washington, D. C.

HEAT OF COMBUSTION AND HEAT OF FORMATION
OF ALUMINUM CARBIDE, by R. C. King and G. T.
Armstrong. [1964] [8]p. incl. diagr. tables, refs.
(AFOSR-66-0353) (ISSA 65-8)   Unclassified

Also published in Jour. Research Nat'l. Bur. Stand.,
v. 68A: 661-668, Nov-Dec. 1964.

The heat of combustion of aluminum carbide (Al_4C_3)
in oxygen was measured by means of bomb calorimetry. The solid product of the combustion consisted of alpha aluminum oxide and another crystalline form of alumina, which was characterized as delta alumina. The heats of combustion were corrected for the formation of the delta aluminum oxide. The results when combined with the heats of formation of alpha aluminum oxide and carbon dioxide, yielded -49.7 kcal mole^{-1} for the standard heat of formation of aluminum carbide at 298.15°K with an estimated overall uncertainty of ± 1.2 kcal mole^{-1}.

1800

National Engineering Science Co., Pasadena, Calif.

LAMB'S PROBLEM FOR AN INHOMOGENEOUS MEDI-
UM WITH CONSTANT VELOCITIES OF PROPAGA-
TION, by T. Karlsson and J. F. Hook. [1963] [16]p.
incl. diagrs. tables, refs. (AFOSR-5354) (AF 49(638)-
1082)   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53:
1007-1022, Oct. 1963.

A recently introduced method of separation of the vec-
tor wave equation of elasticity for certain types of in-
homogeneous, elastic media is employed to study the
two-dimensional problem of an inhomogeneous, iso-
tropic, half-space whose elastic parameters and densi-
ty vary as the square of the depth, leaving the veloci-
ties of propagation of P and S waves constant. The
Rayleigh wave dispersion curve for this medium is ex-
amined. It is found that the medium yields a single
Rayleigh mode with Rayleigh wave phase velocity vary-
ing between the shear velocity and the Rayleigh wave
velocity of a homogeneous medium of the same Pois-
son's ratio. The disturbance generated by an impulsive
surface line load is considered. An exact solution to
this problem is obtained and numerical results for the
displacements are presented and compared to the solu-
tions for the corresponding homogeneous medium. The
displacements vary inversely with depth and the rela-
tive effects of the inhomogeneity as compared to the
homogeneous medium increase with distance from the
source. The displacements at times before and behind
the Rayleigh wave have similar, i.e. approximately
sinusoidal, variation with distance from the source.
(Contractor's abstract)

1801

National Research Corp., Cambridge, Mass.

THE INFLUENCE OF SURFACE PHENOMENA ON THE
MECHANICAL PROPERTIES OF STRUCTURAL MA-
TERIALS (FATIGUE OF ALUMINUM IN VACUUM), by
J. L. Ham. Final rept. Jan. 1, 1961-Jan. 1, 1963.
Aug. 1963, 71p. (AFOSR-4860) (AF 49(638)1005)
AD 413671   Unclassified

Techniques were developed for evaluating the fatigue
life of metals by reverse bending in controlled gaseous
environments including high vacuum, and bombardment.
These techniques were applied to electropolished speci-
mens of commercially pure, half hard rolled aluminum
sheet. The fatigue life of aluminum in reverse bend-
ing at 125 to 140 cps was found to be about seven times
longer in vacuum than in wet air and about four times
longer in vacuum than in dry air. The cyclic strain
causes more surface roughening in vacuum than in air.
A hypothesis based on adsorption equilibrium and im-
munization to cracking by work hardening is proposed
to explain the step change in life with pressure. The
effectiveness of bombardment is ascribed to preven-
tion of crack contamination by migration of mobile
surface gas films.

1802

[Naturalia et Biologia, Paris (France)]

ELECTROPHYSIOLOGIC STUDIES OF THE BASAL
GANGLIA AND STRIOPALLIDAL INHIBITION OF NON-
SPECIFIC AFFERENT ACTIVITY, by G. M.
Krauthamer and D. Albe-Fessard. Jan. 20, 1964,
24p. incl. illus. refs. (AFOSR-65-2832) (AF EOAR-
63-13) AD 629093   Unclassified

Also published in Neuropsychologia, v. 2: 73-83, 1964.

Anatomical and behavioral data are summarized to show
that the function of the basal ganglia extends beyond a
simple control of motor activity. A summary is given
of the neurophysiological data showing that: (a) The
basal ganglia are integrative centers (structures with
convergence properties, receiving messages from
peripheral sense organs as well as the cortex; and (b)
Stimulation of these nuclei (described in the literature)
leads to effects outside the efferent motor pathways.
In cats anesthetized with chloralose, the stimulation of
certain zones in the basal ganglia inhibits the evoked
nonspecific sensory activity at different levels (bulb,
thalamus, cortex) but leaves intact primary sensory
activity. An attempt is made to understand certain ex-
perimental and clinical observations in term of the pos-
sible role that the described inhibition might play in the
normal subject.

1803

Nevada U. Mackay School of Mines, Reno.

STUDY OF SEISMICITY, MECHANICS OF FAULTING
AND CRUSTAL STRUCTURE WITHIN THE BASIN AND
RANGE AND ADJOINING PROVINCES, WITH EMPHA-
SIS ON SEISMIC INFORMATION PROVIDED BY NU-
CLEAR EXPLOSIONS, by D. B. Slemmons, A. Ryall,
and J. I. Gimlett. Final rept. Mar. 1, 1962-Apr. 30,
1964, 5p. (AF AFOSR-62-285) AD 442554
                                          Unclassified

Two new seismographic installations near Tonopah and
Golconda, and additional instruments at the Reno seis-
mographic station have greatly improved the Universi-
ty's capability to investigate in detail seismic activity
of the Basin and Range province. A comprehensive
search of newspapers, earthquake lists, bulletins and
catelogs has produced an earthquake catalog for Nevada
which is complete for the period 1852-1961. A fault
map has been prepared for the Basin and Range province
from photogrammetric studies. Extensive use of IBM
punchcards for recording of data on all phases of the
seismological program has led to adoption of computer
techniques for much of our routine analysis, including
epicenter location. A method for determination of focal
depth has been tested and was found to give promising
results.

1804

Nevada U. Mackay School of Mines, Reno.

COMPUTER PROGRAM FOR AUTOMATIC

PROCESSING OF BASIN AND RANGE SEISMIC DATA, by A. Ryall and A. E. Jones. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-2904) (AF AFOSR-64-646)   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 2295-2310, Dec. 1964.

A program has been written for the University of Nevada's IBM 1620 computer which locates epicenters of seismic events that occur within the Nevada region. The program utilizes readings of P and S waves at up to eight stations in the Basin and Range province, rejects readings for events which are outside the region of interest or events recorded at less than three Nevada stations, establishes trial epicenters for locatable events by means of a table-lookup routine which utilized P-time differences between pairs of stations, and adjusts the trial epicenter by a least-squares procedure based on a sloping-layer crustal model derived from recent U. S. Geological Survey seismic refraction profiles. Epicenters calculated by the program are found to be affected by near-surface structural irregularities in the vicinity of receiving stations, but are not affected either by near-surface features in the source region or direction of the propagation paths with respect to regional structural trends. Travel-time delays calculated for Nevada seismographic stations appear to correlate with Bouguer gravity anomalies at the station sites.

1805

Newcastle U. Dept. of Inorganic Chemistry, Newcastle upon Tyne (Gt. Brit.).

HETEROCYCLIC ORGANOBORON COMPOUNDS. PART II. PREPARATION AND PROPERTIES OF 1-AZA-5-BORATRICYCLO(3, 3, 3, 0) UNDECANE AND RELATED COMPOUNDS, by N. N. Greenwood, J. H. Morris, and J. C. Wright. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0691) (AF EOAR-62-27) AD 616188   Unclassified

Also published in Jour. Chem. Soc. (London), No. 917: 4753-4761, Dec. 1964.

Hydroboronation of the 3 double bonds in triallylamine yields a tricyclic compound (I) with bridgehead nitrogen and boron atoms and a direct B-N bond; it is unreactive, volatile solid which hydrolyzes slowly to dipropylaminopropylboronic acid (II) and tripropylamine. Hydroboronation of triallylborane yields the analogous bicyclic dibora-compound (IV) which is highly reactive and forms adducts with nitrogen donors. The infrared spectrum of azaboratricycloundecane is compared with those of triethanolamine borate and trisethyleneglycol diborate, and its boron and proton nmr spectra are also elucidated.

1606

New Hampshire U. [Dept. of Chemistry] Durham.

ELECTROPHILIC DISPLACEMENT REACTIONS. XV.

KINETICS AND MECHANISM OF THE BASE-CATALYZED PROTODEBORONATION OF ARENEBORONIC ACIDS, by H. G. Kuivila, J. F. Reuwer, Jr., and J. A. Mangravite. [1963] 32p. (AFOSR-5097) (AF 49(638)312) AD 414037   Unclassified

Also published in Canad. Jour. Chem., v. 41: 3081-3090, Dec. 1963.

An investigation of the kinetics of the protodeboronation of benzeneboronic acid in water in the pH range 2.0 to 6.7 is described. In addition to the acid catalyzed reaction studied earlier a reaction whose rate is independent of pH and one whose rate increases linearly with hydroxide ion concentration have been observed. The effect of malonate buffer concentration at low pH confirms the earlier observations of general acid catalysis. Changes in buffer concentration at pH 6.70 have no effect on rate indicating specific hydroxide ion catalysis. Effect of substituents in the ortho, meta and para position of the benzene ring on the rate of photodeboronation have been examined. Ortho-para ratios for this reaction are high; possible reasons for this are discussed. The Hammett equation on using sigma correlates the rates for meta and para substituents.

1807

New Hampshire U. Dept. of Physics, Durham.

CONDUCTION THEORIES IN GASEOUS PLASMAS AND SOLIDS. Final rept. Nov. 1, 1961-Dec. 31, 1962. Mar. 1963, 31p. incl. diagrs. (AFOSR-5119) (AF AFOSR-62-105) AD 414401   Unclassified

The studies were concerned with improving the correlation between theoretical prediction and experimental observation of the transport properties of ionized media. The microwave diagnostic techniques were extended and brought to final completion. With this formulation it is possible to examine in some detail the properties of an anisotropic dielectric or plasma in a geometry which minimizes the effect of boundaries. In addition an attempt was made to ascertain the effect of a modified collision model on the electromagnetic properties of a partially ionized plasma in the presence of a dc magnetic field. The results, while of some theoretical interest, are of negligible practical importance - except possibly in the magnetohydrodynamic limit. The primary efforts concerned (a) Interaction between electromagnetic waves and cold plasmas, and (b) Conductivity theory of partially ionized plasmas.

1808

New Mexico State U. Dept. of Mathematics, University Park.

A PARTIAL ANALYSIS OF GO, by E. O. Thorp and W. E. Walden. [1964] [5]p. incl. diagrs. (AFOSR-66-1750) (AF AFOSR-63-457) AD 641727
                                                Unclassified

Also published in Comput. Jour., v. 7: 203-207, 1964.

A game called Computer Go is defined. Computer Go

differs from the game of Japanese Go only in that certain imprecisely defined conventions have been replaced by precise rules. Some general theorems on Computer Go are given, as well as a scheme for analyzing the game with the aid of a computer. Several reduced versions of Computer Go were analyzed, and the resultant strategies are briefly described.

1809

New Mexico U., Albuquerque.

TRANSFERS IN HANDEDNESS IN THE RAT RESULTING FROM SMALL CORTICAL LESIONS AFTER LIMITED FORCED PRACTICE, by G. M. Peterson and J. V. Devine. [1963] [5]p. incl. illus. diagr. table. (AFOSR-64-0199) (AF 49(638)501) AD 432561
Unclassified

Also published in Jour. Compar. and Physiol. Psychol., v. 56: 752-756, 1963.

This study has shown that building in a certain amount of ability with the nonpreferred hand can increase the likelihood of getting a transfer in handedness with very small lesions. The limit of lesion size may eventually be made smaller but at present it appears to be between 1/2 and 1 cu mm. Even with lesions this large the results indicate that there is no critical area common for all Ss but a shifting of the region in individual Ss. Layers 5 and 6 probably contain the cells controlling handedness, but a more definitive determination requires techniques not at present available.

1810

New Mexico U. Engineering Experiment Station, Albuquerque.

WHOLE-FIELD METHODS IN THE MEASUREMENT OF POST-ELASTIC SURFACE STRAINS, by F. D. Ju. Final rept. June 1963, 103p. (AFOSR-5191) (AF AFOSR-02-208) AD 424340   Unclassified

Several whole-field methods were studied and a new technique was developed for the purpose of measuring post-elastic surface strains in metals. Critical evaluation was given to the following experimental techniques: the moire effect and the birefringent coating. In both methods, the principal experimental model designed for the study of the techniques was a simple tension plate with a central, circular hole as a stress raiser. Fringe patterns developed in both methods were recorded by photography.

1811

New Mexico U. Engineering Experiment Station, Albuquerque.

APPLICATIONS OF LOGARITHMIC THEORY OF PLANE ELASTIC DISLOCATIONS, by F. D. Ju, W. J. Sieger, and D. D. Kana. [1963] [12]p. incl. diagrs. (AFOSR-J1221) (AF AFOSR-62-208) AD 423955
Unclassified

Also published in Jour. Franklin Inst., v. 276: 106-117, Aug. 1963.

The logarithmic theory of plane elastic dislocation is applied to two problems. One deals with a single logarithmic dislocation cut; the second is a dual-radial dislocation cut problem. In both cases, equations developed by the logarithmic theory are employed to solve the stress potential functions. Then the stresses at some pertinent points are obtained for both cases and compared with photoelastic experiments. In both cases, the analytical solutions agree very well with the experimental data.

1812

New Mexico U. Engineering Experiment Station, Albuquerque.

ON THE LOGARITHMIC HYPOTHESIS OF PLANE DISLOCATION STRESS POTENTIAL FUNCTIONS, by F. D. Ju. [1963] [11]p. incl. diagrs. (AFOSR-J1222) (AF AFOSR-62-208) AD 423954   Unclassified

Also published in Jour. Franklin Inst., v. 276: 95-105, Aug. 1963.

The paper presents a comprehensive study for elastic dislocation cuts which initiate from some interior boundary of a multiply-connected plane region and terminate partially in the elastic region. The conditions governing the behavior of material at the neighborhood of the dislocation cut are stated in five theorems. The complex variable representation is chosen as best applied to the plane problem of this type. The complex stress potential functions are defined on a multi-staircase Riemannian surface to provide the necessary discontinuity results. The hypothesis is based on the logarithmic Riemannian surface. Equations, expressing the dislocation theorems, are derived from such logarithmic hypothesis. Together with the boundary conditions, this paper lists the complete set of working equations for this type of plane elastic dislocation problem. (Contractor's abstract)

1813

New Mexico U. Engineering Experiment Station, Albuquerque.

STUDY OF DISLOCATION FAILURE PHENOMENA IN UNIFORM RADIAL AND TENSILE FIELDS, by F. D. Ju. Aug. 20, 1964, 72p. incl. illus. diagrs. (Rept. no. ME-10) (AFOSR-64-1715) (AF AFOSR-63-250) AD 609855   Unclassified

In this report two states of plane elastic dislocation were studied. In one, dislocation patterns were the result of uniform radial stress fields. In another, the dislocation cuts appear in a uni-axial stress field. The uni-axial stress field yields a predetermined pattern of dislocation cuts. But the radial stress field produces dislocation patterns more or less of a random order. The model of the radial stress field problem is a large plate bounded at the interior by a circular hole. The model is subjected to a load that produces a

uniform, radial tensile stress field with respect to the center of the hole, while the edge of the hole remains traction free. According to theoretical analysis and verified by experiments, the maximum shear occurs at the edge of the hole. Upon certain critical loads, the model yields by formation of Lueders bands. The purpose in this report is to study qualitatively the Lueders band pattern and to observe any regularity of its formation.

1814

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

AN EXACTLY SOLUBLE TWO-BODY PROBLEM WITH NON-CENTRAL FORCES, by B. Davies and L. M. Delves. [1963] [3]p. incl. tables. (AFOSR-64-0582) (AF AFOSR-62-400)   Unclassified

Also published in Australian Jour. Phys., v. 16: 311-313, Sept. 1963.

A class of local potentials is given which includes hard cores and a finite-range central, tensor, and L.S. part, and for which the lowest two neutron-proton states are exactly soluble. A numerical example is given in which the form factor for the potentials is a hard core plus square well.

1815

New South Wales U. Dept. of Applied Mathematics Kensington (Australia).

INTEGRATION OVER MULTIDIMENSIONAL HYPER-CUBES. I. A. PROGRESSIVE PROCEDURE, by J. N. Lyness and B. J. J. McHugh. [1963] [7]p. (AFOSR-64-0645) (AF AFOSR-62-400) AD 435929
Unclassified

Also published in Comput. Jour., v. 6: 264-270, Oct. 1963.

A method of numerical integration is described which uses a low order integration rule to obtain a high order result. The error is successively reduced, using a method based on the idea of Richardson's deferred approach to the limit. The method is restricted to hypercubic domains.

1816

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

EXPECTATION VALUES OF VARIOUS OPERATORS IN THE TRITON, by L. M. Delves. [1964] [4]p. incl. tables, refs. (AFOSR-65-1125) (AF AFOSR-62-400)
Unclassified

Also published in Phys. Rev., v. 135: B1316-B1319, Sept. 21, 1964.

The trial functions used in a calculation of the triton

binding energy with realistic forces have been used to derive the expectation values of a number of operators. These include the Coulomb energy for point and for finite protons; various products of powers of the interparticle distances; and the charge and magnetic moment form factors as given by Schiff.

1817

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

FURTHER RESULTS ON THE BINDING ENERGY OF THE TRITON, by J. M. Blatt and L. M. Delves. [1964] [3]p. incl. diagr. tables. (AFOSR-65-1124) (AF AFOSR-62-400) AD 619140   Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 544-546, May 11, 1964.

Three trial wave functions are presented for further investigation of the binding energy of the triton. Significant improvements were obtained in the upper bound of the triton ground-state energy. Results for the three functions are presented and compared to former results.

1818

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

AN UPPER BOUND ON THE NEUTRON-DEUTERON ^{2}S SCATTERING LENGTH, by L. M. Delves and J. M. Blatt. [1964] [3]p. incl. refs. (AFOSR-65-1125) (AF AFOSR-62-400) AD 620471   Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 542-544, May 11, 1964.

The zero-energy experiments on neutron-deuteron scattering (Phys. Rev., v. 83: 700, 1951) lead to a set of quadratic equations for the 2 scattering lengths, a_2, the doublet state, and a_4, the quartet state. This set of equations has 2 solutions. No decision between the solutions is possible on the basis of the data on n-d scattering. Thus, a theoretical calculation is made with the best available nuclear 2-body force laws. The results are presented.

1819

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

UPPER AND LOWER BOUNDS ON GENERALIZED FOURIER COEFFICIENTS, by L. M. Delves. [1964] [6]p. incl. diagrs. (AFOSR-65-1750) (AF AFOSR-62-400) AD 625770   Unclassified

Also published in Jour. Math. Phys., v. 5: 1055-1060, Aug. 1964.

Methods are given for obtaining upper and lower bounds

on the nth Fourier coefficient $C_n^2 \mid \int g^* \sigma U_n \, d\tau \mid^2$ of a function g relative to a sequence of eigenfunctions U_n. These methods fall into three classes: (a) nonvariational upper and lower bounds on C_n^2 which do not involve the solutions of any differential equations; (b) a sequence of nonvariational upper and lower bounds for C_n^2 which involve the solution of a sequence of equations; (c) a variational lower bound on C_n^2. The methods differ in their ease of application and in the amount of information required concerning the eigenvalues associated with the U_n. Some illustrative examples are given.

1820

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

A COMP   ASSIFICATION OF THREE-NU-
CLEO'   " T. Kalotas and L. M. Delves.
[.3(. table. (AFOSR-65-2796)
(A   -400) AD 627677   Unclassified

Nuclear Phys., v. 60: 363-368, 1964.

T   ·hree-nucleon states given by
I   the triton (J = 1/2 π = +) is ex-
tended.   ± arbitrary J^π. (Contractor's abstract)

1821

New South Wales U. Dept. of Nuclear and Radiatic·
Chemistry, Kensington (Australia).

FINE STRUCTURE IN THE DELAYED COINCIDENCE LIFETIME CURVES FOR POSITRONS IN ARGON, by S. J. Tao, J. Bell, and J. H. Green. [1964] [8]p. incl. diagrs. (AFOSR-64-1041) (AF AFOSR-62-398) AD 441494   Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 453-460, 1964.

The lifetimes of positrons in argon and argon-nitrogen mixtures have been measured in more than one hundred experiments. With a high-resolution time-to-pulse-height converter the 'shoulder' after the prompt peak has been studied. The results are interpreted to mean that (1) the τ_2 component is due to the decay of orthopositronium, (2) the shoulder is that part of the τ_1 component arising from the decay of free positrons with energies below the Ore gap and (3) the prompt peak includes the decay of parapositronium, positronium in excited states and metastable collision complexes, for example Are^+, formed from positrons with energies higher than the threshold of the Ore gap. (Contractor's abstract)

1822

New South Wales U. Dept. of Nuclear and Radiation Chemistry, Kensington (Australia).

FORMATION AND QUENCHING OF POSITRONIUM IN GASES. I. RESULTS OBTAINED WITH THE THREE-PHOTON COINCIDENCE METHOD, by G. J. Celitans and J. H. Green. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-1097) (AF AFOSR-62-398) AD 619608   Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 823-831, 1964.

The 3-photon coincidence method has been used to study orthopositronium formation and quenching in argon, nitrogen, oxygen and mixtures of these gases. Quenching rates were found to be proportional to pressure for all gases and gas mixtures, except commercial grade argon. Oxygen-argon mixtures showed a 20% increase in positron   ation for oxygen concentration of the order of 10 parts per million. An increase of about 50% in the formation fraction was obtained for nitrogen-argon mixtures for nitrogen concentrations of about 10%. A uniform quenching rate was found for oxygen-argon mixtures containing up to 0.1% oxygen, and for nitrogen-argon mixtures containing up to 10% nitrogen.

1823

New South Wales U. Dept. of Nuclear and Radiation Chemistry, Kensington (Australia).

FORMATION AND QUENCHING OF POSITRONIUM IN GASES. II. RESULTS OBTAINED WITH THE POSITRON LIFETIME METHOD, by G. J. Celitans, S. J. Tao, and J. H. Green. [1964] [10]p. incl. diagrs. tables. (AFOSR-65-1098) (AF AFOSR-62-398) AD 619609   Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 833-842, 1964.

The positron lifetime method has been used to study orthopositronium formation and quenching in argon, nitrogen, oxygen and mixtures of these gases. Quenching rates were found to be proportional to pressure for all gases and gas mixtures, except commercial grade argon. Highly quenched orthopositronium lifetimes were observed in pure argon and the formation fraction of positronium was estimated as 0.40 ± 0.04. The quenching rate in oxygen was found to be $(2.3 \pm 0.3) \times 10^7$ sec^{-1} atm^{-1}. This rate holds for oxygen concentration greater than 2% in oxygen-argon mixtures. A constant quenching rate $(2.51 \pm 0.05) \times 10^5$ sec^{-1} atm^{-1} was obtained for lower oxygen concentrations; this rate is not significantly different from the quenching rate $(2.42 \pm 0.07) \times 10^5$ sec^{-1} atm^{-1} obtained for nitrogen-argon mixtures containing less than 10% nitrogen.

1824

New South Waies U. Dept. of Nuclear and Radiation
Chemistry, Kensington (Australia).

RANGE DISTRIBUTION OF ^{22}Na POSITRONS IN ARGON
AND NITROGEN, by G. J. Celitans and J. H. Green.
[1963] [4]p. incl. diagrs. (AFOSR-65-1099)
(AF AFOSR-62-398) AD 619610   Unclassified

Also published in Proc. Phys. Soc. (London), v. 82:
1002-1005, 1963.

Range distributions of ^{22}Na positrons have been meas-
ured in argon and nitrogen, using a 2-photon coinci-
dence apparatus. The distributions are compared with
theoretical positron path length distributions, and are
used to calculate correction factors applicable to the
study of positronium formation in gases.

1825

New South Waies U. Dept. of Nuclear and Radiation
Chemistry, Kensington (Australia).

ANNIHILATION RATES AND COLLISION COMPLEX
OF POSITRONS IN FREON-12, by J. H. Green and
S. J. Tao. [1963] [2]p. incl. diagr. tabie. (AFOSR-
65-1100) (AF AFOSR-62-398) AD 619139
Unclassified

Also published in Jour. Chem. Phys., v. 39: 3160-
3161, Dec. 1, 1963.

The lifetimes of positrons in Freon were measured at
pressures from 1 to 5 atm. The apparatus used in the
investigation depended on a wide-range nanosec time-
to-pulse-height converter. For the ionger iifetime
component of positronium, the pressure coefficient is
found to be 0.56 x 10^6 sec^{-1} atm^{-1}. The shorter
component is so small that at pressures above 2 atm it
is scarcely detectable but does appear quite definitely
at iower pressures.

1826

New York State Psychiatric Inst., N. Y.

CARBON DIOXIDE FIXATION IN VERTEBRATE AND
INVERTEBRATE NERVOUS TISSUE, by S. Berl,
S. C. Cheng, and H. Waelsch. [1964] [6]p. (AFOSR-
64-0955) (AF AFOSR-62-221) AD 439987
Unclassified

Also published in Compar. Neurochem., June 10-15,
1962, p. 207-212.

Significant CO_2 fixation in the brain of an animal in
vivo was demonstrated, with the aid of C^{14} bicarbo-
nate. The mechanism of cerebral CO_2 fixation ap-
pears to be analogous to that in iiver. It was of par-
ticular interest to ascertain whether CO_2 fixation is a
characteristic of the mammalian brain only or occurs
also in nervous tissue in general. For such a study,

the nerves of the walking iegs of the lobsters were
chosen. In this nervous tissue also, CO_2 fixation could
be demonstrated. It appears probable that in both tis-
cues CO_2 is fixed via the citric acid cycle. The find-
ings suggest that carbon dioxide fixation is a general
property of the metabolism of nervous tissues.

1827

New York State Psychiatric Inst., N. Y.

SOME QUANTITATIVE ASPECTS OF THE FIXATION
OF CARBON DIOXIDE BY THE LOBSTER NERVE, by
S.-C. Cheng and H. Waeisch. [1963] [10]p. (AFOSR-
64-0956) (AF AFOSR-62-221) AD 439988)
Unclassified

Also published in Biochem. Zeitschr., v. 338: 643-
653, 1963.

When lobster nerves are incubated in NaH$_{14}$CO$_3$-con-
taining Ringer's soiution considerabie radioactivity is
found in the intermediates of the tricarboxyiic acid cy-
cie and closely related amino acids. The ratios of the
specific activities of giutamate: aspartate:malate were
found to be 1:3:25. The average contents of glutamate,
aspartate, and malate were found to be 0.39, 3.9, and
0.24 μmoi/mg of protein (3.7% protein in lobster
nerve). With paired nerves from the same animal, and
glucose in the incubation medium, the variability of the
vaiues could be kept within 25%. Ouabain (0.4 mM) re-
duced the fixation of CO_2. The findings demonstrate a
significant CO_2 fixation in the nerve of an invertebrate
animai.

1828

New York State Psychiatric Inst., N. Y.

TRANSGLUTAMINASE AND HISTAMINE INCORPORA-
TION IN VIVO, by M. Ginsburg, 1. Wajda, and H.
Waeisch. [1963] [14]p. (AFOSR-64-0958) (AF AFOSR-
62-221) AD 439990   Unclassified

Aiso pubiished in Biochem. Pharmacol., v. 12: 251-
264, 1963.

Incorporation of histamine into iiver protein of mice
was investigated; the activity of transglutaminase, the
enzyme that catalyzes the incorporation in vitro of
amines into protein was determined simuitaneously.
Although the amount of histamine bound to iiver pro-
tein is negligible in untreated control mice, after the
administration of Salmonella typhosa endotoxin and
Haemophilus pertussis vaccine, agents which increase
transgiutaminase activity in mouse iiver, a definite
fixation of histamine in liver proteins was found. The
increase in enzyme activity and the amount of protein-
bound histamine showed a significant correlation. When
the incorporation of the amine was studied with C^{14},
the relatively iow radioactivity of the incorporated his-
tamine suggested an extensive dilution of the labeled
amine by unlabeied histamine. Methods for the

determination of small amounts of protein-bound un-labeled histamine and of labeled histamine from C^{14} labeled proteins are described.

1829

New York State Psychiatric Inst., N. Y.

RNA POLYMERASE IN THE CENTRAL NERVOUS SYS-TEM, by S. C. Bondy and H. Waelsch. [1964] [4]p. incl. refs. (AFOSR-65-0303) (AF AFOSR-63-443) AD 611922   Unclassified

Also published in Life Sci., v. 3: 633-636, 1964.

RNA polymerase in cerebral cortex is higher than in other regions of the rabbit brain. The average activity of the brain nuclei is higher than that of the liver nu-clei. During development, the activity of RNA poly-merase increases with maturation.

1830

New York State Psychiatric Inst., N. Y.

QUANTITATIVE ASPECTS OF CO_2 FIXATION IN MAMMALIAN BRAIN IN VIVO, by H. Waelsch, S. Berl and others. [1964] [12]p. incl. refs. (AFOSR-65-0304) (AF AFOSR-63-443) AD 612228
                    Unclassified

Also published in Jour. Neurochem., v. 11: 717-728, 1964.

The data presented in this paper support the conclusion that CO_2 fixation in the mammalian brain is a process which responds to the change in the metabolic environ-ment. The rate of CO_2 fixation is increased when the tissue is exposed to a metabolic stress, such as ele-vated ammonia concentraion, which results in an in-creased synthesis of glutamine. The data show that CO_2 fixation is of considerable significance in brain metabolism and not negligible. It plays an essential role in maintaining the concentration of dicarboxylic acids in the citric acid cycle. The continuous removal of oxoglutarate without replenishment would lead to a breakdown of the citric acid cycle and consequently to a deficiency in the production of ATP, although the data suggest that CO_2 fixation may well replenish the intermediates of the citric acid cycle in case of in-creased ammonia concentration in brain tissue, these acute experiments give no answer as to the chronic effects of ammonia on the citric acid cycle.

1831

New York State U. Dept. of Chemistry, Buffalo.

DIELECTRIC CONSTANT OF HYDROGEN-BONDED LIQUIDS. II. N-MONOSUBSTITUTED ACETAMIDES, by R.-Y. Lin. [1963] [6]p. (AFOSR-J1523) (AF AFOSR-63-271) AD 426559   Unclassified

Also published in Jour. Phys. Chem., v. 67: 1805-1810, 1963.

Dielectric constants and densities of acetamides, CH_3CONHR, with R methyl, ethyl, butyl, isobutyl, sec-butyl and 1-naphthyl are given. Enthalpy, entropy and free energy of the hydrogen bond formation are discussed.

1832

New York State U. Dept. of Chemistry, Buffalo.

DIELECTRIC CONSTANT OF HYDROGEN BONDED LIQUIDS. III. SUPERHEATED ALCOHOLS, by W. Dannhauser and L. W. Bahe. [1964] [9]p. (AFOSR-64-1519) (AF AFOSR-63-271) AD 446369
                    Unclassified

Also published in Jour. Chem. Phys., v. 40: 3058-3066, May 15, 1964.

The dielectric constants of the eight lowest aliphatic al-cohols have been measured from room temperature to their respective critical temperatures. The densities were also measured if they were not previously avail-able. The data were analyzed in terms of Kirkwood's correlation factor based on a model of linear, hydrogen bonded chains with restricted rotation about the hydro-gen bond and variable degree of polymerization. The equilibrium constants are strongly dependent on the size and shape of the alkyl group.

1833

New York State U. Dept. of Chemistry, Buffalo.

DIELECTRIC CONSTANT AND INTERMOLECULAR ASSOCIATION OF SOME LIQUID NITRILES, by W. Dannhauser and A. F. Flueckinger. [1964] [6]p. (AFOSR-64-1794) (AF AFOSR-63-271) AD 449048
                    Unclassified

Also published in Jour. Phys. Chem., v. 68: 1814-1819, July 1964.

Densities and equilibrium dielectric constants of propio-, acrylo-, pivalo-, benzo-, and 2,6-dimethyl-benzonitrile were measured from near their melting points to about 200°C. The Kirkwood-Frohlich corre-lation factor is less than unity in each case and gen-erally increases with increasing temperature. The dielectric data are analyzed on the basis of an equilib-rium between monomer and an antiparalleled dipole pair dimer, and the nature of the association is dis-cussed.

1834

New York State U. Dept. of Physics, Buffalo.

ATOMIC DIPOLE POLARIZABILITIES FROM THE UN-COUPLED HARTREE-FOCK APPROXIMATION, by M.

Yoshimine and R. P. Hurst. [1964] [6]p. incl. tables, refs. (AFOSR-65-0402) (AF AFOSR-63-191) AD 612753   Unclassified

Also published in Phys. Rev., v. 135: A612-A617, Aug. 3, 1964.

Electric dipole polarizabilities are computed for a large number of 2-, 3-, 4-, 10-, 11-, 12-, 18-, 19-, and 20-electron atoms and ions. These results are all obtained within the framework of the uncoupled Hartree-Fock approximation. All calculations are made using analytical Hartree-Fock wave functions. For the lighter atoms and positive ions the results of these calculations are in fairly good agreement with the experimental and other more accurate theoretical values. However, for the heavier atoms and ions the results are too large. It is also found that great care must be exerted in selecting self-consistent functions for use in making polarizability calculations.

1835

New York State U. [Dept. of Physics] Buffalo.

MAGNETIC SUSCEPTIBILITY OF 2 $^3S_1$ STATE OF HELIUM AND SOME LIKE IONS, by J. T. McMullan and R. P. Hurst. [1964] [5]p. incl. tables, refs. (AFOSR-65-0441) (AF AFOSR-63-191) AD 612457   Unclassified

Also published in Phys. Rev., v. 135: A973-A977, Aug. 17, 1964.

The magnetic susceptibility of the 2 $^3S_1$ state of helium and some like ions is computed using a 35 term wave function of the type originally proposed by Hylleraas and Undheim. It is found that it is possible to obtain highly accurate values for the magnetic susceptibility using this wave function if the parameters are accurately determined. Finally, an argument is given which suggests that the magnetic susceptibility obtained in the present work is accurate to at least 5 significant figures.

1836

New York State U. Dept. of Chemistry, Stony Brook.

FURTHER EVIDENCE FOR THE NORMAL CYANIDE STRUCTURE OF GeH_3CN, by T. D. Goldfarb and B. P. Zafonte. [1964] [2]p. incl. tables. (AFOSR-65-0687) (AF AFOSR-63-277) AD 615694   Unclassified

Also published in Jour. Chem. Phys., v. 41: 3653-3654, Dec. 1, 1964.

To confirm the normal cyanide structure for the product of reaction of germyl iodide with silver cyanide, the vibrational frequency shifts were observed for 58% C^{13}- and 98% N^{15}-substituted GeH_3CN and GeD_3CN.

A simple linear MCN or MNC model and a valence force field with no interaction force constants were used to predict the frequency shifts. The observed frequencies of GeH_3CN and GeD_3CN were used to calculate a separate set of stretching force constants for each of these molecules, and these were then used to compute the frequencies of C^{13}- and N^{15}-substituted species. Results are presented in a table.

1837

New York U. Courant Inst. of Mathematical Science, N. Y.

MACROSCOPIC MAGNETO-FLUID DYNAMICS, by J. Berkowitz and H. Grad. Final rept. Sept. 1964, 8p. (AFOSR-64-1647) (AF 49(638)1006) AD 605532   Unclassified

A general program was undertaken to understand the mathematical structure and content of the basic equations of the subject, paying special attention to non-standard mathematical problems which arise. The steady flow past a wedge was studied. The Mach cones in three dimensions were computed and found to be extremely singular. The flow past an airfoil, governed at certain intermediate speeds by a fourth order 'composite' system which is partly elliptic and partly hyperbolic, was studied. An extensive existence theory of the linear Boltzmann equation was developed using newly discovered estimates for the Boltzmann collision operator. Also, a detailed study of wave propagation using normal modes was made.

1838

New York U. Courant Inst. of Mathematical Sciences, N. Y.

RESEARCH IN MATHEMATICAL PROBLEMS. Final rept. Nov. 1, 1962-Oct. 31, 1963 [13]p. incl. refs. (AFOSR-J1515) (AF AFOSR-62-108) AD 429255   Unclassified

Brief abstracts are given of reports dealing with differential equations, partial differential equations, and special functions. Some of the reports completed or in process are: Alternative representations for nonself-adjoint boundary value problems; An atypical problem for linear ordinary differential equations; Instability intervals of Hill's equation; Generalized eigenvectors and separation of variables; Generalized limiting amplitude principle; and Analysis of the Watson Transformation.

1839

[New York U. Courant Inst. of Mathematical Sciences, N. Y.]

STABILITY PROBLEMS FOR SYSTEMS OF LINEAR DIFFERENTIAL EQUATIONS, by M. Segal. [1964] (AFOSR-65-1407) (AF AFOSR-62-108) AD 621562   Unclassified

Also published in Commun. Pure and Appl. Math.,
v. 17: 401-414, Nov. 1964.

This investigation considers problems of stability of
differential equations with periodic coefficients aris-
ing from real bi-linear forms. Only the symmetric
case is analyzed in detail; however, the technique
used applies to the antisymmetric case with small
modification. Pairs of the form $d = (T(t), Y(t))$ are
considered where T and Y are real n x n matrices; T
is continuous, and Y(t) satisfies $\frac{d}{dt} Y = TY$, $Y(0) = 1$.

1840

New York U. [Courant Inst. of Mathematical Sciences]
N. Y.

OPTIMAL STRATEGIES IN FACTORIAL EXPERI-
MENTS, by S. Ehrenfeld and S. Zacks. [1963] [12]p.
(AFOSR-J1126) (AF AFOSR-62-153) AD 421163
Unclassified

Also published in Ann. Math. Stat., v. 34: 780-791,
Sept. 1963.

The present study is concerned with randomization
procedures in fractional factorial experiments. The
general problem is to choose, in an optimal manner,
a fractional replication of a full factorial system and
an estimator, for the purpose of making inferences
concerning a subset of pre-assigned parameters.

1841

New York U. Courant Inst. of Mathematical Sciences,
N. Y.

THEORY OF THE BOLTZMANN EQUATION, by H.
Grad. Aug. 1964, 27p. incl. refs. (Rept. no. MF-
40) (AFOSR-64-1377) (AF AFOSR-62-266) AD 610162
Unclassified

Presented at Eleventh Internat'l. Cong. of Applied
Mechanics, Munich (Germany), Aug. 1964.

A survey is presented of recent developments in the
theory of the Boltzmann equation for a dilute mona-
tomic gas. In the singular limit of small mean free
path, the traditional Hilbert and Chapman-Enskog ex-
pansions have been shown to be asymptotic to true
solutions of the Boltzmann equation, but only when the
variables are appropriately interpreted. At the oppo-
site extreme of large mean free path where the be-
havior is again nonuniform, the precise mathematical
singularities have been exposed. Over the whole
range of linear problems the presence of a continuous
spectrum in both the collision operator and the stream-
ing operator points to the inadequacy of traditional ex-
ponential 'normal mode' expansions in both initial and
boundary value problems. Results in all the regimes
have been tied together by the overall qualitative under-
standing given by a more comprehensive existence
theory which, for the first time, is broad enough to
encompass the transition to macroscopic continuum
flow. (Contractor's abstract, in part)

1842

New York U. Courant Inst. of Mathematical Sciences,
N. Y.

A UNIFORMLY VALID ASYMPTOTIC THEORY OF
RARIFIED GAS FLOWS UNDER THE NEARLY FREE-
MOLECULE CONDITIONS, by Y.-P. Pao. Dec. 18,
1964, 125p. incl. diagrs. refs. (Rept. no. MF-43)
(AFOSR-65-0276) (AF AFOSR-62-266) AD 612079
Unclassified

An asymptotic theory for obtaining nearly free-mole-
cule solutions which are uniformly valid throughout the
flow field of an infinite rarefied gas is proposed in the
present study for the linearized Boltzmann equation
with hard-sphere molecules. Power-law molecules
can be treated in a like manner. The theory is based
on a new integral formulation of the linearized Boltz-
mann equation. An inner-and-outer-expansion pro-
cedure is used. The simplification in the inner region
is that the collisional effects are only secondary while
outside of the inner region the angle subtended by the
body is small so that the flow field is essentially that
created by a source at the origin. In order to examine
the mathematical nature of this asymptotic theory, a
two-dimensional circular cylinder rotating in a rare-
fied gas, which is at rest at infinity, is studied. It is
proved that the inner and outer solutions obtained by
the theory are indeed asymptotic to the true solution
throughout the physical space.

1843

New York U. Courant Inst. of Mathematical Sciences,
N. Y.

DRAG ON AN OBJECT IN NEARLY-FREE MOLECU-
LAR FLOW, by M. H. Rose. [1964] [8]p. incl. refs.
(AFOSR-67-1248) (AF AFOSR-62-266)
Unclassified

Also published in Phys. Fluids, v. 7: 1262-1269, Aug.
1964.

In the nearly-free molecular flight of a body through a
neutral gas the departure from free-flow conditions
becomes marked within roughly the distance of a mean
free path from the body. This is the region to be
studied here. In order to do this as simply as possi-
ble, the distribution function for the gas is assumed to
be governed by the Krook equation with the addition of
a point source term; this term is identified with the
radial flow issuing from the object and is easily related
to its shape and to the boundary condition both at its
surface and at infinity. The Krook equation may be
linearized about the distribution function at infinity and
then solved using Fourier transform techniques. The
knowledge thus obtained of the distribution function near
the body leads to the expression for the first order
perturbation of the drag over its free-molecular value.
This is the exact first-order solution in the sense that
all collisions between particles are taken into account
and not merely "first collisions." The case of a sphere
undergoing diffuse reflection at high Mach number is
worked out in detail and an explicit expression for the
drag is derived.

1844

New York U. Courant Inst. of Mathematical Sciences, N. Y.

THE ENERGY DECAY OF SOLUTIONS TO THE INI-TIAL-BOUNDARY VALUE PROBLEM FOR THE WAVE EQUATION IN AN INHOMOGENEOUS MEDIUM, by B. B. Lieberman. June 1964, 18p. (Research rept. no. BR-45) (AFOSR-64-1642) (AF AFOSR-64-537) AD 605508   Unclassified

The paper is concerned with the decay of the energy of disturbances which are propagated according to the wave equation with variable index of refraction in the exterior of a finite star-shaped reflecting body. It is shown that the energy of the disturbance decays like some t^{-1}. Certain conditions of growth and continuity are made on the index in order to insure some decay factor. The energy decay is obtained by estimating the solution of an integral equation which results when one applies the Friedrichs' 'A-B-C method' to the modified wave equation operator. Using the energy estimate with other familiar estimates, one obtains a rate of decay for the disturbance itself. (Contractor's abstract)

1845

New York U. Data Processing and Computation Lab., N. Y.

THE MEASUREMENT OF VOCALIC AND TONAL CONTEXTS, by D. Rothenberg. Final rept., pt. 1, Dec. 1964, 7p. (AFOSR-65-0129) (AF AFOSR-64-484) AD 610597   Unclassified

A mathematical model has been developed that defines a collection of sets each of which can be used to 'meas-ure' the distance between any pair of a given finite set of points in such manner that the distance, as defined by a procedure for counting points on the measuring set, is invariant under translation of such measuring set. A circular model has been applied to the percep-tion of tones in context, and a 'Gestalt' theory of per-ception results from the interpretation. Predictions suitable for experimental verification or refutation of the model are provided by the results of computations performed. These results are in accord with the musical materials and practices of all the cultures thus far examined. Previously unexplained peculari-ties of Balinese music are accounted for. Discrepan-cies between Indian musical theory and practice are explained. Examination of other non-western musical cultures lends further support to the theory.

1846

New York U. [Dept. of Chemistry] N. Y.

ORIENTATION AND REACTIVITY IN FREE RADICAL AROMATIC SUBSTITUTION, by R. T. Morrison. Final technical rept. 1961-1963. Apr. 17, 1964, 8p. (AFOSR-64-1108) (AF AFOSR-62-34) AD 601695   Unclassified

A method of analysis of biaryl mixtures was worked out that gives rate factors about ten times as accurate as previous methods have given; and a method was de-vised for collecting reference samples of biaryls that eliminates the need for lengthy synthesis. Rate factors were measured by this method for eight peroxide-substrate systems, and it was found that these results are consistent with the operation of polar effects. It was found that, in certain cases, the esters reported from peroxide decomposition are not the simple sub-stituted phenyl benzoates previously assumed. Data were obtained about the effect of oxygen and peroxide concentration on yield of benzoic acid that strongly sug-gest the operation of a cage effect in free radical substitution.

1847

New York U. Dept. of Electrical Engineering, N. Y.

CONTROL SYSTEMS, by S. S. L. Chang and J. Ragazzini. Final rept. Mar. 1, 1962-Apr. 30, 1963, 18p. (AFOSR-64-1005) (AF AFOSR-62-321) AD 602685   Unclassified

The report is concerned with basic theoretical research in the area of 'control systems theory.' The report summarizes the research work performed. The cen-tral problem of this project was optimal control sys-tems and their realization.

1848

New York U. Dept. of Electrical Engineering, N. Y.

THE GENERAL THEORY OF DIGITAL FILTERS WITH APPLICATIONS TO SPECTRAL ANALYSIS, by K. Steiglitz. May 1963 [112]p. incl. diagrs. refs. (Tech-nical rept. no. 400-99) (AFOSR-64-1664) (AF AFOSR-62-321) AD 609980   Unclassified

The filtering theories for both continuous-time and dis-crete-time signals are formulated in terms of abstract Hilbert space, with the notion of a stable filter defined as a bounded linear operator. A specific isomorphism is then constructed which connects the filtering theories for continuous-time and discrete-time signals, and in the linear time-invariant case the two theories are shown to be essentially identical. This means that many optimization problems can be solved simultaneously for continuous-time and digital systems. The isomorphism developed above is used to reduce the approximation problem for digital filters to that for continuous-time filters. The problem of estimating the power-spectral-density of a signal from equally spaces samples is dis-cussed. It is shown that bandpass digital filters gen-erate a class of spectral windows which produce always positive estimates of the power-spectral-density. The optimum bandwidth and shape of such a filter are then derived. A method for identifying unknown pa-rameters in the power-spectral-density of a digital signal is presented.

1849

[New York U. Dept. of Electrical Engineering, N. Y.]

THE COST FUNCTION AND ITS MINIMIZATION: FOR
A GENERAL CLASS OF SELF-ADAPTIVE SYSTEMS,
by H. J. Perlis. [1964] [13]p. (AFOSR-64-1830)
(AF AFOSR-62-321)   Unclassified

This paper presents a detailed analysis of a general
class of self-adaptive systems under realistic condi-
tions. The particular set of systems considered are
those in which the following conditions exist: the nomi-
nal transmittance of the time-varying primary system
is known, there are k varying parameters and 2Q ad-
justable parameters, output transducer noise is not
negligible, and the spectral densities of the parameter
variations and of the measurement noise are known.
The auxiliary systems are closed-loop and employ
perturbation-correlation identification techniques. An
over-all system, quadratic cost function expression is
developed. This is shown to be a function of the vari-
ance of the system transmittance which, in turn, is a
function of the spectral properties of the parameter
variations and the measurement noise. An optimization
procedure is presented for minimizing the cost func-
tion of the over-all, self-adaptive system.

1850

[New York U. Dept. of Electrical Engineering, N. Y.]

THE MINIMIZATION OF MEASUREMENT ERROR IN
A GENERAL PERTURBATION-CORRELATION
PROCESS IDENTIFICATION SYSTEM, by H. J. Perlis.
[1964] 11p. incl. diagrs. refs. (AFOSR-64-2127)
(AF AFOSR-62-321) AD 452380   Unclassified

Also published in IEEE Trans. Automatic Control,
Oct. 1964, p. 332-339.

A general identification system is studied for an im-
portant class of realistic, time-varying processes.
This class consists of those in which the process is
nominally known and the statistical characteristics of
its varying parameters and of the environment also
are known. The expression for identification error in
terms of the spectral properties of the parameter vari-
ations and of the output transducer noise is developed.
Optimization procedures are given to minimize the
perturbation-correlation system's mean square identi-
fication error.

1851

New York U. [Dept. of Electrical Engineering] N. Y.

A GEOMETRIC TEST SYNTHESIS PROCEDURE FOR A
THRESHOLD DEVICE, by P. Kaszerman. Mar. 29,
1963, 20p. incl. diagrs. refs. (Technical rept. no.
400-79) (AFOSR-64-0391) (AF AFOSR-63-24)
AD 435652   Unclassified

Also published in Inform. and Control, v. 6: 381-398,
Dec. 1963.

A Boolean function may be defined as a mapping from
the vertices of an n-dimensional hypercube whose
vertices are n-tuples of 1 and -1 to (0, 1). A threshold
function is then a Boolean function whose 1 or TRUE
vertices are separable from the 0 or FALSE vertices
by a hyperplane. Using this geometric representation,
one may show that a threshold device realization may
be approximated as follows: Form the vector sum of the
TRUE vertices. The components of the resultant vec-
tor can then serve as the weights. The threshold is
approximated by 2 to the n-1 minus the number of
TRUE vertices. If the function under consideration is
a threshold function, the vector formed from the first
approximation and the threshold may be repeatedly ro-
tated until it converges on a position such that its com-
ponents form an exact threshold device realization.
A specific procedure for performing these rotations is
given.

1852

New York U. [Dept. of Electrical Engineering] N. Y.

ON THE SYNTHESIS OF THRESHOLD DEVICES, by P.
Kaszerman. Sept. 1963, 127p. incl. diagrs. refs.
(Technical rept. no. 400-84) (AFOSR-64-0394)
(AF AFOSR-63-24) AD 437294   Unclassified

A Boolean function of n variables may be defined as a
mapping from the vertices of an n-dimensional hyper-
cube to (TRUE, FALSE). A threshold function is de-
fined as a Boolean function whose TRUE vertices are
separable from the FALSE vertices by a hyperplane.
It is shown that the vertices of the above hypercube lie
on the surface of a hypersphere and are distributed
uniformly over the surface of this hypersphere. A
comparison is made between a threshold function and a
continuous threshold functions, i. e., the set of points
on the surface of the hypersphere which lie on the TRUE
side of the hyperplane. Based on this comparison, an
approximate threshold device realization for any
Boolean function is developed. Further, an algorithm
is derived which, starting with the approximation, de-
velops a valid realization if the function is a threshold
function.

1853

New York U. Dept. of Electrical Engineering, N. Y.

ALGORITHMS FOR THE ENCODING OF THREE-DI-
MENSIONAL GEOMETRIC FIGURES, by K. Ruttenberg.
June 1963, 1v. incl. diagrs. tables. (Technical rept.
no. 400-86) (AFOSR-64-0560) (AF AFOSR-63-24)
AD 434320   Unclassified

Procedures are developed for the chain encoding of
lines, planes, conic sections, and quadric surfaces.
Encoding of geometric figures in terms of chains fa-
cilitates their analysis and manipulation with a digital
computer. Various algorithms for chain encoding are
introduced and it is shown how basic algorithms can be
combined to solve the problem of the intersection of a
plane with a closed surface.

1854

New York U. [Dept. of Electrical Engineering] N. Y.

A CRITERION FOR QUANTIZATION OF PLANAR CON-
TOURS, by J. M. Glass. Feb. 1964, 48p. incl. illus.
diagrs. (Technical rept. no. 400-91) (AFOSR-64-
0940) (AF AFOSR-63-24) AD 600310   Unclassified

A criterion is presented for choosing the grid size
used when planar contour curves are encoded in digital
form. The criterion is based on representing the
curves by flexed, thin elastic beams and measuring the
corresponding strain energy. This energy is compared
with that obtained from a 'smoothest possible' curve,
or minimum-energy curve, which is shown to be
uniquely determined by the quantized data. This mini-
mum-energy curve serves as a reconstructed approxi-
mation to the original curve. The energy difference
between the two curves, which varies with the grid
size, is used as a basis for deciding how well the
quantized data represent the original curve. In par-
ticular, the criterion requires that the minimum-en-
ergy curve generated from the quantized data repro-
duce the highest strain-energy density sections of an
original curve to within some prescribed tolerance.

1855

New York U. Dept. of Electrical Engineering, N. Y.

A STUDY OF THE CHAIN-DIFFERENCE CORRELA-
TION TECHNIQUE FOR CONTOUR LINE PATTERNS,
by E. B. Socci. Mar. 1964, 54p. incl. diagrs. tables.
(Technical note no. 400-22) (AFOSR-64-0941)
(AF AFOSR-63-24) AD 600276   Unclassified

A correlation technique for contour-line patterns which
is invariant to rotation is described. The technique is
based on the so-called chain-encoding method for con-
tour-line data, in which a given contour is represented
by a 'chain' of elements that in sequence trace out the
contour path. The correlation technique permits a com-
parison between two contours without regard to rela-
tive orientation or scale. It is based directly on the
intrinsic curvature properties of contour-line patterns.
An algorithm for forming correlation sequences is de-
veloped and programmed for a digital computer. Re-
sults obtained by correlating some sample contours
are discussed. (Contractor's abstract)

1856

New York U. [Dept. of Electrical Engineering] N. Y.

APICTORIAL JIGSAW PUZZLES: THE COMPUTER
SOLUTION OF A PROBLEM IN PATTERN RECOGNI-
TION, by H. Freeman and L. Garder. [1964] [10]p.
(AFOSR-64-1386) (AF AFOSR-63-24) AD 444464
                                    Unclassified

Also published in IEEE Trans. Electron. Comput.,
v. EC-13: 118-127, Apr. 1964.

This paper describes the development of a procedure
that enables a digital computer to solve "apictorial"

jigsaw puzzles, i.e., puzzles in which all pieces are
uniformly gray and the only available information is the
shape of the pieces. The problem was selected because
it provided an excellent vehicle to develop computer
techniques for manipulation of arbitrary geometric
patterns, for pattern identification, and for game
solving. The kinds of puzzles and their properties are
discussed in detail. Methods are described for charac-
terizing and classifying piece contours, for selecting
and ordering pieces that are "most likely" to mate with
a given piece, for determining likelihood of fit, for
overcoming ambiguities, and for evaluation of the
progressive puzzle assembly. An illustration of an
actual computer solution of a puzzle is given.

1857

New York U. [Dept. of Electrical Engineering] N. Y.

A NONLINEAR-SUMMATION THRESHOLD DEVICE, by
P. Kaszerman. May 1, 1963, 2p. (AFOSR-64-1391)
(AF AFOSR-63-24) AD 444462   Unclassified

Also published in IEEE Trans. Electron. Comput. Dec.
1963, p. 914-915.

This note describes a particular network consisting of
AND circuits and a single linear-summation threshold
device which realizes Boolean functions identified by
boundaries other than hyperplanes. It is referred to
as a 'nonlinear-summation threshold device.' A spe-
cific synthesis procedure is given as well as a method
for generating the desired boundary. In contrast to
the linear-summation threshold device, the nonlinear-
summation threshold device is capable of realizing any
Boolean function.

1858

New York U. Dept. of Electrical Engineering, N. Y.

ON THE ANALYSIS AND SYNTHESIS OF SWITCHING
NETWORKS COMPOSED OF M-OUT-OF-N DECISION
GATES, by M. Raship. June 1964, 128p. incl. diagrs.
tables, refs. (Technical rept. no. 400-95) (AFOSR-
64-1378) (AF AFOSR-64-24) AD 604043
                                    Unclassified

A formal algebra, called m-out-of-n decision logic, is
developed for the analysis and synthesis of switching
networks made up of m-out-of-n decision gates. An
m-out-of-n decision gate is defined as a device that
can be described by a threshold function whose weights
and threshold are positive integers. Such a threshold
function is also referred to as m-out-of-n decision
function. A set of theorems is derived from an axiom
set, and the inclusion of Boolean algebra and 3-input
majority-decision logic as special cases of the m-out-
of-n decision logic is demonstrated.

1859

New York U. Dept. of Electrical Engineering, N. Y.

ON THE REALIZATION OF BINARY SWITCHING

FUNCTIONS WITH MAJORITY GATES, by M. Raship. Sept. 30, 1964, 38p. (Technical rept. no. 400-100) (AFOSR-64-2495) (AF AFOSR-64-24) AD 609504
Unclassified

For switching circuit design with majority gates, an augmented function is derived that permits the residue test to determine which of the constants 0 and 1 as well as which of the literals of a binary switching function must appear as inputs in a realization. An approach to the realization of switching functions with majority gates based on having only these required literals and constants as inputs is shown to be useful. A synthesis procedure employing this approach is presented that yields an upper bound on the number of stages required. A table is derived of all switching functions which may be realized with a network composed of two stages of three-input majority gates.

1660

New York U. Dept. of Electrical Engineering, N. Y.

AN ALGEBRAIC-GEOMETRIC TECHNIQUE FOR THE REALIZATION OF SWITCHING FUNCTIONS WITH M-OUT-OF-N DECISION GATES, by M. Raship. Oct. 1964, 34p. incl. diagrs. (Technical rept. no. 400-101) (AFOSR-64-2496) (AF AFOSR-64-24) AD 609505
Unclassified'

An algebraic-geometric technique is presented for the realization of binary switching functions with networks composed of m-out-of-n decision gates. An m-out-of-n decision gate is defined as a device that may be described by a threshold function whose weights and threshold are positive integers. An expansion theorem is proved that can produce a variety of gate configurations ranging between the two extremes of $2(n-1)$ stages of 3-input majority gates, and a 2-stage form composed of gates having a much greater number of inputs. For realization with two stages, the terms of the expansion theorem may be mapped on to one-half of a Karnaugh diagram. The map displays all possible combinations of terms which may be combined according to the m-out-of-n decision logic, and provides a basis for formalizing the initial step in a reduction procedure. (Contractor's abstract)

1661

New York U. Dept. of Electrical Engineering, N. Y.

PATTERN-ANALYSIS OF PLANAR GEOMETRIC CONFIGURATIONS, by H. Freeman. Final rept. Nov. 1, 1963-Dec. 31, 1964 [26]p. incl. diagr. (AFOSR-65-0389) (AF AFOSR-64-24) AD 612020   Unclassified

The study covered five separate investigations. Of these, four were directly concerned with the processing of encoded graphical data in a digital computer, and the fifth was concerned with a special form of majority logic, the so-called m-out-of-n decision logic. The report briefly summarizes these investigations and lists the publications (with abstracts) resulting from the research work.

1662

New York U. Dept. of Electrical Engineering, N. Y.

RESEARCH INVESTIGATIONS IN SYSTEMS THEORY, by J. K. Wolf and J. R. Ragazzini. Final rept. Oct. 1, 1963-Sept. 30, 1964. Oct. 1, 1964, 16p. (AFOSR-64-2176) (AF AFOSR-64-499) AD 609450
Unclassified

The following investigations are discussed: A study of time-optimal controls for continuous and sampled data systems, The synthesis of approximately optimal control systems, The synthesis of multiple loop feedback amplifiers, Cumulative codes as variable redundancy codes, On an extended class of error-locating codes, On codes derivable from the tensor product of check matrices, The cost function and its minimization for a general class of self-adaptive systems, The minimization of measurement error in a general perturbation-correlation, process identification system, and The utilization of external, correlated signals to reduce the self-adaptive cost function.

1663

New York U. Dept. of Electrical Engineering, N. Y.

CUMULATIVE CODES AS VARIABLE REDUNDANCY CODES, by J. K. Wolf. [1964] [7]p. incl. diagrs. (AFOSR-65-0333) (AF AFOSR-64-499) AD 611936
Unclassified

Also published in IEEE Internat'l. Convention Record, Pt. 5: 66-72, 1964.

A cumulative decision feedback system is considered whereby the digits are decoded on the basis of all the digits in all of the repeated blocks. If an (n, k) binary group code is repeated (N-1) times, the resultant digits are considered as nN-tuples derived from an (nN, k) code. The parity check matrix, minimum distance and generator polynomial (for cyclic codes) are determined for the (nN, k) code. A method for partitioning the error detection and correction capabilities of the (Nn, k) code is suggested on the basis of a constant fail-safe probability criterion.

1664

[New York U. Dept. of Physics, N. Y.]

THE GENERATION AND PROPAGATION OF WAVES IN A COMPRESSIBLE ATMOSPHERE, by D. W. Moore and E. A. Spiegel. [1964] [24]p. (AFOSR-64-0605) (AF AFOSR-62-366) AD 436372   Unclassified

Also published in Astrophys. Jour., v. 139: 46-71, Jan. 1, 1964.

The equations governing the aerodynamic generation and the propagation of waves in a compressible atmosphere are exhibited. Fluctuating terms which are turbulent sources for aerodynamic noise are approximated by an externally applied, time-harmonic, point force. Lighthill's results for the asymptotic radiation field in

an anisotropic medium are applied to an isothermal atmosphere. The surfaces of constant phase, group velocity, and intensity of the far field are computed. For finite frequencies above the critical frequency for vertical propagation, a monopole component is produced in the field by gravitational effects. The propagation problem is studied for arbitrary temperature profiles, and in certain regions in the solar atmosphere there exist finite bands of non-propagating frequencies. The oscillations in the solar atmosphere should result from forced excitations of these non-propagating frequencies.

1665

New York U. [Dept. of Physics] N. Y.

THE EFFECT OF RADIATIVE TRANSFER ON CON-VECTIVE GROWTH RATES, by E. A. Spiegel. [1964] [16]p. (AFOSR-64-1978) (AF AFOSR-62-366) AD 452397   Unclassified

Also published in Astrophys. Jour., v. 139: 959-974, Apr. 1, 1964.

Calculations of the convective growth rate, η are carried out for an inviscid, radiating, polytropic layer. The effect of a radiative damping is studied in two special cases. First assume a layer thickness much less than the scale height, but with arbitrary optical thickness of disturbances. In this case the growth rate is a monotonically increasing function of the horizontal wavenumber, k. Second, the case of a layer of arbitrary vertical extent is considered, but only for disturbances with large k. In this case, Newton's law of cooling is valid for the perturbation equations. When the polytropic index, m, is 6, it is demonstrated that for the convective modes, η approaches the non-radiative value for large k, while for the acoustic modes overstability can occur. Arbitrary values of m are then treated in the boundary-layer approximation.

1666

Nobel Inst. for Physics, Stockholm (Sweden).

RANGE DISTRIBUTIONS OF W^{167} IONS OF KEV EN-ERGIES IN TUNGSTEN, by J. Uhler, B. Domeij, and S. Borg. [1963] [7]p. (AFOSR-J657) (AF EOAR-62-66) AD 416381   Unclassified

Also published in Arkiv Fysik, v. 24: 413-419, 1963.

Until now no measurements of complete range distributions of an ion in its own element have been made. In this work the ranges of W^{167} ions in the energy interval 1.6-127 kev are measured. Comparison is made with distributions of noble gas ions in W. The data confirm the significance of the distributions obtained for ranges of gas ions. The ranges found are shown to be considerable larger than predicted by theory.

1867

Nobel Inst. for Physics, Stockholm (Sweden).

PROTON ANGULAR DISTRIBUTIONS FROM $O^{16}(d, p)O^{19}$ AT ED EQUALS 7.0 MEV, by G. Wickenberg, S. Hjorth and others. [1963] [11]p. (AFOSR-64-0639) (AF EOAR-62-66) AD 435943   Unclassified

Also published in Arkiv Fysik, v. 25: 191-201, May 22, 1963.

The angular distributions of protons corresponding to the 0, 0.096, 1.47 and 2.35 mev O^{19} states from the reaction $O^{18}(d, p)O^{19}$ and of elastically scattered deuterons by O^{16} have been measured at a bombarding energy of 7 mev. DWBA analyses of the distributions have been performed by G. R. Satchler and some results from these calculations are shown. For the (d, p) transitions to the ground state and 1.47 mev state spectroscopic factors agree well with those obtained from PWBA analyses as well as with those previously measured at 15 mev deuteron energy.

1668

North American Aviation, Inc. Atomics International Div., Canoga Park, Calif.

RESEARCH ON PROPERTIES OF HIGH CURRENT, LOW FREQUENCY ELECTRODELESS DISCHARGES, by C. A. Guderjahn. Annual technical summary rept. 1964, 45p. (Rept. no. AI-64-46) (AFOSR-64-0999) (AF 49(636)1222) AD 603935   Unclassified

Alternating current, low pressure electrodeless discharges were excited in cesium, rubidium, potassium, and mercury vapors by magnetic induction. In each case the discharge tube was a toroid forming the secondary of an iron core transformer whose frequency range was 1 to 40 kc. The resistivities of the discharges were measured as a function of current density (1 to 30 amp/sq cm) and pressure (1 to 300 microns). The discharges were diffusion controlled and strongly ionized with electron-charged particle interactions being the principal contribution to resistivity. Resistivities were of the order of 0.2 omega cm.

1669

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

STEADY-STATE ROCKET COMBUSTION OF GASEOUS HYDROGEN AND LIQUID OXYGEN. PART I. EX-PERIMENTAL INVESTIGATION, by L. P. Combs and F. W. Hoehn. June 1964, 56p. incl. illus. diagrs. (Research rept. no. 64-24) (AFOSR-64-1952) (AF 49-(638)617) AD 615796   Unclassified

Combustion of gaseous hydrogen and liquid oxygen was studied experimentally under rocket conditions in an uncooled transparent-walled two-dimensional combustion chamber which simulated a 1-inch-wide diametrical section of a conventional cylindrical rocket combustor.

Tests were made with three injector types using hydrogen chilled to simulate regenerative rocket engine injection temperatures. Photographic data were obtained which yielded considerable qualitative insight and quantitative information concerning the propellant combustion processes. (Contractor's abstract)

1870

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

THE ANHARMONICITY CORRECTION FOR POLY-ATOMIC MOLECULES. PART II. METHANE, by E. C. Curtis. [1964] [18]p. incl. tables, refs. (AFOSR-65-0568) (AF 49(638)1135) AD 614088
Unclassified

Also published in Jour. Molec. Spectros., v. 14: 292-307, Nov. 1964.

The anharmonic correction to the vibrational frequencies of methane and all of its deuterium and tritium substituted derivatives was computed using a method reported earlier. The harmonic force constants and anharmonicity parameters were determined by Jones and McDowell. To compare this method to the conventional Dennison method it was necessary to devise an arbitrary method of classifying vibrations. This is described and the fit is satisfactory in both cases. The vibrational frequencies are then calculated for the unmeasured unsymmetrically substituted derivatives of methane.

1871

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

THE ANHARMONICITY CORRECTION FOR POLY-ATOMIC MOLECULES. PART I. METHODS AND APPLICATION TO CH_2O, by E. C. Curtis. [1984] [13]p. incl. diagr. tables, refs. (AFOSR-65-0589) (AF 49-(638)1135) AD 614177
Unclassified

Also published in Jour. Molec. Spectros., v. 14: 279-291, Nov. 1964.

A new approach is offered for computing anharmonicity factors for simple polyatomic molecules from the observed fundamental vibrational frequencies. This involves addition of terms for anharmonicity to a conventional normal coordinate analysis based on the amplitude of the normal vibrations. For an example, the method is applied to formaldehyde in several degrees of approximation, one of which was able to reproduce the observed frequencies within the experimental error.

1872

North American Aviation, Inc. [Space and Information Systems Div.] Downey, Calif.

RECENT STUDIES IN BOUNDARY LAYER

TRANSITION, by E. R. van Driest. Nov. 1963, 36p. (Rept. no. SID-64-548) (AFOSR-64-0589) (AF 49-(638)1178) AD 437283
Unclassified

Presented at Founders' meeting of the Society of Engineering Science, Purdue U., Lafayette, Ind., Nov. 4-6, 1963.

Experimental effects of controlled surface roughness and freestream turbulence on boundary layer transition are described and theoretical correlations of the data presented. Recent results on the transition of boundary layers in non-Newtonian fluids are also discussed. It is found that a small increase in fluid plasticity strongly delays transition.

1873

North American Aviation, Inc. Space and Information Systems Div., Downey, Calif.

STUDIES ON BOUNDARY LAYER TRANSITION FOR YEARS 1963-64, by E. R. van Driest and C. B. Blumer. Summary rept. Dec. 1964, 31p. incl. diagrs. tables. (Rept. no. SID-64-2191) (AFOSR-65-0203) (AF 49(638)1178)
Unclassified

The present report reviews the results of studies on boundary layer transition carried out during the years 1963-64 under the above contract. Studies included (a) effect of cooling on roughness-induced transition, (b) effect of roughness on transition on the face of a blunt body, (c) non-newtonian effects, and (d) roughness effects in hypersonic flow. (Contractor's abstract)

1874

[North American Philips Co., Inc.] Philips Labs., Irvington-on-Hudson, N. Y.

EVALUATION OF TRUNCATION METHODS FOR ACCURATE CENTROID LATTICE PARAMETER DETERMINATION, by J. Taylor, M. Mack, and W. Parrish. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-65-0159) (AF 49(638)620) AD 611501
Unclassified

Also published in Acta Cryst., v. 17: 1229-1245, Oct. 1964.

The centroid method provides a rational approach to the problem of the accurate determination of lattice parameters. The method requires (1) precise measurement of the line profiles; (2) calculation of the centroid; (3) correction of the centroid for aberrations, goniometer calibration, etc., and (4) knowledge of the centroid of the incident spectral distribution. Four proposed methods for establishing finite limits by truncating a diffraction line profile are reviewed. The methods are evaluated from both a theoretical and practical viewpoint and the superiority of 1 of the methods is demonstrated. The effects of $K\beta$ lines, $K\alpha$ satellite lines and the background on the centroid are discussed. Lattice parameters of silicon and tungsten derived using both $FeK\alpha$ and $CuK\alpha$ radiations are given. The results are free of systematic error, and it appears that

the centroid method can be used to obtain lattice parameters of greater accuracy than has been possible before, provided accurate spectral centroid data can be obtained.

1875

[North American Philips Co., Inc.] Philips Labs., Irvington-on-Hudson, N. Y.

METHODS OF DETERMINING CENTROID X-RAY WAVELENGTHS: CuKα AND FeKα, by M. Mack, W. Parrish, and J. Taylor. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-85-0181) (AF 49(638)620) AD 456499   Unclassified

Also published in Jour. Appl. Phys., v. 35: 1118-1127, Apr. 1964.

Centroids of CuKα and FeKα two-crystal spectrometer profiles prepared by Bearden have been calculated and corrected for axial divergence, distortions arising from variation in absorption across the spectral distributions, crystal asymmetry, and other factors. To determine the centroid wavelength it is necessary to truncate the profile; equivalence of λ and θ is maintained by truncating the powder and spectral profiles in the same manner. Four methods for systematically truncating the profiles have been published; the methods are evaluated and the superiority of one of the methods is demonstrated. It is shown that the centroid wavelength is a function of integration (wavelength) range, primarily as a result of inclusion or exclusion of the Kα satellite group within the truncated profile. The two-crystal spectrometer profiles are compared with models based on a Cauchy distribution. The necessity for additional spectral data before reference centroid wavelengths can be established is discussed. (Contractor's abstract, in part)

1876

North Carolina State Coll. [Dept. of Mathematics] Raleigh.

THE EFFECT OF A PENNY-SHAPED CRACK ON THE DISTRIBUTION OF STRESS IN A LONG CIRCULAR CYLINDER, by I. N. Sneddon and R. J. Tait. Apr. 18, 1983, 19p. (AFOSR-J1518) (AF 49(838)1159) AD 427982   Unclassified

Also published in Internat'l. Jour. Eng. Sci., v. 1: 391-409, 1963.

An analysis is presented of the distribution of stress in a long circular cylinder of elastic material when it is deformed by the application of pressure to the inner surfaces of a penny-shaped crack situated with its center on the axis of the cylinder and its plane perpendicular to that axis. It is assumed that the cylindrical surface is free from shear and is supported in such a way that the radial component of the displacement vector vanishes on the surface. By making a suitable representation of the stress function for the problem, the problem is reduced to the solution of a Fredholm integral equation of the second kind. Expressions for

the various quantities of physical interest are derived for small values of the ratio of the radius of the crack to that of the cylinder by finding an iterative solution of this equation. For values of this ratio near unity the integral equation has been solved numerically using a high-speed computer and the relevant quantities calculated.

1877

North Carolina State Coll. [Dept. of Mathematics] Raleigh.

AN EXTERNAL CRACK PROBLEM WITH ASYMMETRICAL LOADING, by M. Lowengrub. Sept. 20, 1983, 9p. (AF AFOSR-83-444) AD 421177   Unclassified

Considered is the problem of determining the distribution of stress in an infinite elastic solid containing an external crack which is opened by the application of an asymmetrical pressure. Throughout, it is assumed that the equations of the classical (infinitesimal) theory of elasticity hold.

1878

North Carolina State Coll. [Dept. of Mathematics] Raleigh.

NUMERICAL TREATMENT OF AN INTEGRAL EQUATION ARISING IN A MIXED-BOUNDARY ELASTICITY PROBLEM, by J. T. Welch, Jr. Apr. 28, 1984, 48p. (AF AFOSR-63-444) AD 437920   Unclassified

The non-singular Fredholm integral equation is solved numerically. The equation has been derived by Sneddon and Collins in the analytical treatment of the stress field in a long cylinder containing a penny-shaped crack being opened by an arbitrary axially symmetric pressure. In the discussion of the numerical treatment, emphasis is on techniques which allow the treatment of additional cases, without excessive recomputation. Results are given for constant, parabolic and step pressures across the crack, with variations in crack width and Poisson's ratio. The shape of the crack is also obtained in many cases.

1879

North Carolina State Coll. Dept. of Mathematics, Raleigh.

THE USE OF TRANSFORM METHODS IN ELASTICITY, by I. N. Sneddon. Nov. 8, 1964, 193p. incl. diagrs. tables. (AFOSR-64-1789) (AF AFOSR-84-444) AD 453791   Unclassified

These notes give a fairly complete account of the applications of the theory of the more familiar integral transforms (Fourier and Hankel) to the solution of boundary value problems in elastostatics. The first chapter contains some introductory materials on the equations of elastic equilibrium and their solution. Chapter II is concerned with plane strain problems and uses only the theory of Fourier transforms. In Chapter

III three-dimensional problems are considered and here one of the natural tools to use is the Hankel transform. The remaining two chapters are given over to the treatment of two special classes of spatial problems—the calculation of thermal stresses and the solution of certain simple forms of the contact problem. Some unfamiliar properties of Fourier and Hankel transforms are collected together in an appendix.

1880

North Carolina U. [Dept. of Mathematics] Chapel Hill.

ON A BOUND USEFUL IN THE THEORY OF FACTOR-IAL DESIGNS AND ERROR CORRECTING CODES, by R. C. Bose and J. N. Srivastava. [1964] [7]p. (AFOSR-4833) (AF AFOSR-63-84) AD 611931
Unclassified

Also published in Ann. Math. Stat., v. 35: 408-414, Mar. 1964.

Consider a finite projective space $PG(r - 1, s)$ of $r - 1$ dimensions, $r \geq 3$, based on the Galois field GF_s, where $s = p^h$, p being a prime. A set of distinct points in $PG(r - 1, s)$ is said to be a non-collinear set, if no three are collinear. The maximum number of points in such a non-collinear set is denoted by $m_3(r, s)$. It is the object of this paper to find a new upper bound for $m_3(r, s)$. This bound is of importance in the theory of factorial designs and error correcting codes. The exact value of $m_3(r, s)$ is known when either $r \leq 4$ or when $s = 2$. When $r \geq 5$, $s > 3$, the best values for the upper bound on $m_3(r, s)$ are due to Tallini and Barlotti. Our bound improves these when $s = 3$ or when s is even.

1881

North Carolina U. [Dept. of Mathematics] Chapel Hill.

THE CONSTRUCTION OF TRANSLATION PLANES FROM PROJECTIVE SPACES, by R. H. Bruck and R. C. Bose. [1964] [18]p. incl. refs. (AFOSR-65-0091) (AF AFOSR-63-84) AD 455737 Unclassified

Also published in Jour. Algebra, v. 1: 85-102, Apr. 1964.

Can every (nonDesarguesian) projective plane be imbedded (in some natural, geometric fashion) in a (Desarguesian) projective space? The question is new but imports it, ior, if the answer is yes, two entirely separate fields of research can be united. This paper provides a conceptually simple geometric construction which yields an affirmative answer for a broad class of planes. A plane π is given by the construction precisely when π is a translation plane with a coordinatizing right Veblen-Wedderburn system which is finite-dimensional over its left-operator skew-field. The condition is satisfied by all known translation planes, including all finite translation planes. (Contractor's abstract)

1882

North Carolina U. [Dept. of Physics] Chapel Hill.

RADIATION DETECTION BY DECORATION IN SILVER CHLORIDE CRYSTALS, by C. B. Childs and L. M. Slifkin. 1963, 29p. (AFOSR-J1553) (AF 49(638)865) AD 427405 Unclassified

A review is given of the decoration of imperfections in silver halides with emphasis on volume decoration used in radiation detection. The selection, preparation, and decoration of silver chloride crystals are discussed with illustrations of decorated imperfections. Examples of primary cosmic ray particles and high energy proton collisions in silver chloride crystals are presented. The unique features of these crystals as radiation detectors are absence of humidity effects, absence of distortion, nonchemical development at room temperature, delineation of tracks in less than two hours, and crystal thicknesses greater than 3000μ.

1883

North Carolina U. Dept. of Physics, Chapel Hill.

THEOREM ON SEPARATION OF VARIABLES WITH APPLICATION TO STATIC-SOURCE MESON THEORY, by E. A. Remler. [1964] [5]p. (AFOSR-65-0480) (AF AFOSR-63-153) AD 616463 Unclassified

Also published in Phys. Rev., v. 136: B491-B495, Oct. 26, 1964.

A general formulation is given of the process by means of which one eliminates certain redundant degrees of freedom occurring in interacting quantum-mechanical systems. This may be considered a generalization of the transformation to center of mass in problems having translational invariance. When applied to the pion-nucleon system, the static-source approximation arises as the first term in a series, the higher terms of which are easily calculable using an algorithm developed in the Appendix. This system is not an expansion in the inverse mass of the nucleon, and it is shown that the static approximation need not be considered as a non-relativistic approximation.

1884

North Carolina U. Dept. of Physics, Chapel Hill.

FALLING CHARGES, by C. M. DeWitt and B. S. DeWitt. [1964] [18]p. incl. refs. (AFOSR-65-0481) (AF AFOSR-63-153) AD 614166 Unclassified

Also published in Physics, v. 1: 3-20, 1964.

The radiative damping force on an electrically charged particle falling freely in a static weak gravitational field is computed in the nonrelativistic limit of small velocities. It is shown that, in this limit, the force separates naturally into 2 components: (1) a conservative part which arises from the fact that the mass of the particle is not concentrated at a point but is partly distributed as electric field energy in the space

surrounding the particle and (2) a non-conservative part which depends linearly on both the velocity and the Riemann tensor. The conservative force is shown to correspond to a repulsive inverse square potential and to make a retrograde contribution to the perihelion precession. The nonconservative part is shown to produce an average energy loss identical with that of the traditional formula which is used for accelerations caused by nongravitational forces. Because the nonconservative force depends on the velocity rather than its 2nd derivative, however, the phenomenon of preacceleration does not occur with gravitational forces.

1885

North Dakota State U. Coll. of Chemistry and Physics, Fargo.

THE ANODIC OXIDATION OF CHLORIDE TO PERCHLORATE ON A SEMI-MICRO SCALE, by J. E. Billigmeier and R. L. McDonald. [1964] [3]p. incl. diagr. table. (AFOSR-64-1506) (AF AFOSR-63-65) AD 446368   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 663-665, 1964.

A non-compartmentalized cell was designed which gives good conversion of LiCl to LiClO$_4$ while operating with a total liquid volume of 3 ml or less. Results of the electrolysis of both LiCl and HCl solutions are presented. A good yield of perchlorate can be obtained from LiCl in a matter of 6 hr or less. On the other hand with HCl the yield is poor even after 24 hr of electrolysis. The pronounced decrease in yield observed after 24 hr for HCl may not be real. The KClO$_4$ recovered in this run was extremely fine and thus difficult to filter; some loss may have occurred. This work demonstrates that it is possible to obtain high yields of perchlorate from small volumes of relatively dilute LiCl solutions.

1886

North Dakota State U. Coll. of Chemistry and Physics, Fargo.

IRON (III) EXTRACTION BY NITROBENZENE-BENZENE MIXTURES (Abstract), by R. L. Erickson and R. L. McDonald. [1964] [1]p. (AFOSR-65-2071) (AF AFOSR-63-65) AD 628826   Unclassified

Also published in Proc. North Dakota Acad. Sci., v. 18: 112, 1964.

In the present work, the solvation of HFeCl$_4$ by nitrobenzene in the inert diluent benzene has been studied by observing the variation of the distribution ratio with nitrobenzene concentration while all other variables are held constant. The extracted metal species existing in the organic phase at nitrobenzene concentrations greater than 3 M may be represented as HFeCl$_4$ - 14PhNO$_2$- x H$_2$O where x is being determined. At nitrobenzene concentrations below approxi-

mately 3.0 M the data are inconclusive. The large number of nitrobenzene molecules per metal atom may indicate that the anion is also solvated in this system.

1887

Northrop Corp., Hawthorne, Calif.

TRANSITION FROM AMBIPOLAR TO FREE DIFFUSION IN A DECAYING PLASMA. CASE I - INITIAL DISTRIBUTION A DIRAC DELTA "FUNCTION", by C. D. Maldonado. Jan. 1963, 45p. incl. diagrs. (Rept. no. NSL-63-15) (AFOSR-5072) (AF 49(638)-1160)   Unclassified

The hypotheses of congruence and proportionality are used to study the transition from ambipolar to free diffusion in a decaying plasma. Time dependent "imperfect" ambipolar diffusion coefficients are obtained for both the electrons and ions. For a decaying plasma which is initially a Dirac delta distribution and in a quasi-neutral state, the temporal evolution of these diffusion coefficients is from a common limit of "perfect" ambipolar diffusion to their respective limits of free diffusion as time increases. The period or time required to make this transition is different for both coefficients and depends to a great extent on the initial number of charged particles. Plots of these coefficients as a function of the initial number of charged particles for different values of time and vice versa are presented. Also for a given initial number of charged particles the spatial behavior of the charge density, electric field and potential consistent with Poisson's equation are plotted for different values of time during the transition period. (Contractor's abstract)

1888

Northrop Corp., Hawthorne, Calif.

THREE-FLUID NONEQUILIBRIUM PLASMA ACCELERATORS. PART II, by P. D. Lenn, J. R. Bodoia and others. [1963] 25p. (AFOSR-J767) (AF 49(638)-1160) AD 414040   Unclassified

Presented at AIAA Electric Propulsion Conf., Colorado Spring, Mar. 11-13, 1963.

The three-fluid theory of nonequilibrium plasma flow with emphasis on crossed-field accelerators is extended through the use of improved analytical models and less restrictive physical assumptions. A theory of the heat transfer to the electrodes of a crossed field accelerator is developed which includes the effects of the three-fluid behavior of the plasma and of the applied electromagnetic fields. The analysis indicates that the electrical power dissipation in the electrode drop region is the major source of heat transfer to cold electrodes. Experimental heat transfer values were determined from calorimetric measurements on the water-cooled electrodes. Data obtained over a range of magnetic field strengths, accelerator power levels and channel pressures are shown to fit a correlation of the form developed analytically.

1669

Northrop Corp., Hawthorne, Calif.

PLASMA PROPERTIES BY MOMENTUM CHANGE, by
P. D. Lenn and D. L. Ward. May 1964, 65p. incl.
illus. diagrs. tables, refs. (AFOSR-64-1000) (AF 49-
(638)1160) AD 603097   Unclassified

The use of the momentum change technique to deter-
mine average properties of a plasma from its interac-
tion with applied electric and magnetic fields was in-
vestigated. Experiments were performed using a lin-
ear crossed field accelerator. An analysis for the
calculation of average values of the scalar conductivity,
Hall coefficient and ion slip coefficient is developed and
applied to experimental results obtained with argon at
the pressures of 2, 4 and 6 mm Hg. From those val-
ues, the electron temperature and number density and
the mean electron-ion collision time were calculated.
Assuming a relation between the electron and heavy
particle temperatures, the heavy particle densities, the
mean ion-atom collision time and the ion-atom colli-
sion cross-section were calculated.

1690

Northrop Corp., Hawthorne, Calif.

MOMENTUM TRANSFER TO PLASMAS BY LORENTZ
FORCES, by S. T. Demetriades. [1964] [32]p. incl.
illus. diagrs. refs. (AFOSR-64-2252) (AF 49(638)-
1160) AD 452371   Unclassified

Also published in Physico-Chemical Diagnostics of
Plasmas, 1964, p. 297-326.

A theoretical and experimental study of momentum
transfer to plasmas by Lorentz forces is described.
A generalized Ohm's law is used to predict changes in
the direction and magnitude of the momentum of a
stream of plasma and other observable macroscopic
effects in a crossed-field accelerator in terms of spe-
cies temperatures and concentrations and other plas-
ma parameters. The assumption of local thermal
equilibrium is not required in this approach. Measure-
ments of momentum change and other effects are pre-
sented that are substantially in agreement with theory.
Gross mean estimates of the plasma parameters in the
cross-arc region are obtained from the measured mo-
mentum changes and power input. (Contractor's
abstract)

1691

Northrop Corp., Hawthorne, Calif.

THREE-FLUID NONEQUILIBRIUM PLASMA ACCEL-
ERATORS. PART I, by S. T. Demetriades, G. L.
Hamilton and others. [1963] [50]p. incl. illus. diagrs.
tables, refs. (AF 49(636)1160)   Unclassified

Presented at the ARS Electric Propulsion Conf.,
Berkeley, Calif., Mar. 14-16, 1962.

Published in Astronaut. and Rocketry, v. 9: 461-511,
1963.

A three-fluid theory of nonequilibrium plasma flow is
developed, and the underlying assumptions are dis-
cussed, with emphasis on crossed-field plasma accel-
erators. Use is made of a simplified model of the
geometry of the discharge to analyze the effect of mag-
netic induction on the thrust at constant total current.
The mechanism of current transfer between low-tem-
perature electrodes is also discussed. Measurements
are reported of mass flow rate, thrust, axial pressure
distribution, total current, electrode voltage, magnetic
induction, electrode and insulator erosion, and elec-
trode cooling rates for a continuous crossed-field ac-
celerator. The plasma generator and accelerator were
connected by a gas-tight adapter and were both mounted
on the thrust stand. Mass flow rates from 0.001 to
0.003 lbm/sec were used, and thrust levels of up to
3.6 lb were developed. Water cooled copper electrodes
were employed with negligible erosion rates. Electrode
power losses were about 20% of accelerator power.
Accelerator running times are currently limited by
test-tank heating to approximately 30 min at these power
levels. The experimental results are shown to be in
agreement with the theoretical analysis based on Cow-
ling's 3-fluid current density equation.

1692

Northrop Corp., Hawthorne, Calif.

INVESTIGATION OF THE SCATTERING OF A LASER
BEAM BY THE ELECTRONS OF A PLASMA, by D. W.
McMorris and H. N. Olsen. Dec. 1964, 36p. incl.
illus. diagrs. tables, refs. (Rept. no. NSL-64-166-1)
(AFOSR-65-0033) (AF 49(638)1336) AD 610167
          Unclassified

The radiation scattered from the beam of a laser by
free electrons of a test plasma has been investigated as
a possible tool for plasma diagnostics at electron densi-
ties in the range of 10^{16} to 10^{17} cm^{-3} and temperatures
from 10,000°K to 20,000°K. A perturbing effect on the
plasma background-radiation was observed which
masked the expected Thomson scattering. This per-
turbation is interpreted as a plasma heating resulting
from energy transferred to the plasma from the laser
beam by coupling of the electromagnetic field with the
plasma charged particles.

1693

Northwestern U. Dept. of Chemistry, Evanston, Ill.

KINETICS AND MECHANISMS OF THE HYDROLYSIS
OF SOME CHLORAMMINERHODIUM(III) COMPLEXES,
by S. A. Johnson, F. Basolo, and R. G. Pearson.
[1963] [7]p. incl. diagrs. tables, refs. (AFOSR-4707)
(AF 49(638)315) AD 429276   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85:
1741-1747, June 20, 1963.

The rates of hydrolysis of certain chloramminerhodi-
um(III) complexes were investigated as a function of

steric effects, the extent of chelation and other variables. It was observed that various nucleophiles have no effect on the rate of chloride ion release from these systems. These results are similar to the behavior of analogous cobalt(III) systems. Striking differences were also found: (1) the rate of reaction of a rhodium(III) complex is insensitive to the charge on the complex, (2) alkali has little or no effect on the rate of hydrolysis and (3) reactions of rhodium(III) complexes occur with almost complete retention of configuration. These results are discussed in terms of probable mechanisms for reactions of rhodium(III) complexes. (Contractor's abstract)

1894

Northwestern U. [Dept. of Electrical Engineering] Evanston, Ill.

A NEW REFLECTION COEFFICIENT FOR LOW DENSITY, by M. A. Plonus. 1964, 3p. (AFOSR-64-2544) (AF 49(838)1377) AD 453885   Unclassified

Also published in Proc. Nat'l. Electronics Conf., Chicago, Ill., v. 20: 14-18, Oct. 1964.

Scattering from an aggregate of particles can usually be divided into two kinds, an incoherent and a coherent scatter. Incoherent scattering results when the distribution of particles is random. It can be shown that the boundaries which define a particle system will give rise to a coherent scatter, since in a sense a boundary can be looked upon as a particular variation in density of particles. After some mathematical manipulations, one discovers that this coherent scatter from the boundaries is really the physical optics scatter of a dielectric body whose shape coincides with that of the boundaries of the particle system. By exploring this relationship, which essentially relates Rayleigh scattering of the individual particles to the physical optics scattering of the particle system, a new definition for reflection coefficient from the boundaries of a dielectric body can be made. In this paper it is shown that this method can be successfully applied to a simply-shaped dielectric body which is made of a dielectric whose losses are small and the dielectric constant is approximately equal to unity.

1895

Northwestern U. Dept. of Electrical Engineering, Evanston, Ill.

OPTIMUM LOCATIONS OF SWITCHING CENTERS AND THE ABSOLUTE CENTERS AND MEDIANS OF A GRAPH, by S. L. Hakimi. [1964] [10]p. (AFOSR-64-2321) (AF AFOSR-83-98) AD 452325   Unclassified

Also published in Operations Research, v. 12: 450-459, May-June 1964.

The concepts of the 'center' and the 'median vertex' of a graph are generalized to the 'absolute center' and the absolute median' of a weighted graph (a graph with weights attached to its vertices as well as to its branches). These results are used to find the optimum

location of a switching center in a communication network and to locate the best place to build a 'police station' in a highway system. It is shown that the optimum location of a switching center is always at a vertex of the communication network while the best location for the police station is not necessarily at an intersection. Procedures for finding these locations are given. (Contractor's abstract)

1896

Northwestern U. Dept. of Electrical Engineering, Evanston, Ill.

GENERATION AND REALIZATION OF TREES AND K-TREES, by S. L. Hakimi and D. G. Green. [1961] [9]p. (AFOSR-84-2322) (AF AFOSR-63-98) AD 452324
                                              Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-11: 247-255, June 1964.

In this paper is considered an analysis-synthesis problem in graph theory. The analysis problem is that of efficient generation of trees, 2-trees, and k-trees of a given labeled graph. The synthesis problem is that of finding a graph that realizes a given set of trees, 2-trees, or realizes given sets of trees and 2-trees simultaneously. These results have a strong bearing upon topological analysis and synthesis of electrical networks.

1897

Northwestern U. Dept. of Electrical Engineering, Evanston, Ill.

A NOTE ON ACTIVE RC REALIZATION OF VOLTAGE TRANSFER FUNCTIONS, by L. S. Bobrow and S. L. Hakimi. [1964] [2]p. incl. diagr. (AFOSR-65-1012) (AF AFOSR-83-98) AD 614554   Unclassified

Also published in IEEE Trans. on Circuit Theory, v. CT-11: 493-494, Dec. 1964.

The usual practice in active RC synthesis of using ideal negative impedance converters or ideal controlled sources is postulated to be unnecessary. It is shown that any rational voltage transfer function can be realized by a grounded network containing resistors, capacitors, and any 3 vacuum tubes or transistors. A vacuum tube circuit is used in the investigation. It is also shown that there are no restrictions on the values of plate resistances or amplification factors, and therefore the tubes can be replaced by field-effect transistors.

1898

Northwestern U. [Dept. of Electrical Engineering] Evanston, Ill.

ON THE PROBABILISTIC NETWORKS, by Y. Fu. 1963, 17p. (AF AFOSR-83-98) AD 438497
                                              Unclassified

A probabilistic network is defined as a linear graph with its branch weights being statistically independent discrete random variables. A general probabilistic network function is formulated in terms of the reliabilities of individual branches. Application to probabilistic switching network is also considered.

1899

Northwestern U. [Dept. of Electrical Engineering] Evanston, Ill.

VERTEX REDUCTION NETWORK ANALYSIS, by H. Frank. Mar. 1, 1964, 44p. (Technical rept. no. 9) (AF AFOSR-63-98) AD 438498   Unclassified

The problem of topological network analysis is discussed, and various methods of tree generation summarized. It is concluded that no totally satisfactory method is available to generate the trees of a graph. The 'pliars entry' and generalized star mesh transformations are then introduced and a method to reduce any multi-port passive network to a three terminal representation is described. The concepts thus developed are extended to include active networks whose currents have unique solutions. Finally, the applications of the reduction techniques to digital computer solutions are considered, and several related problems are introduced.

1900

Northwestern U. Dept. of Materials Science, Evanston, Ill.

MAGNETIC STUDY OF DEFORMATION IN AN AGE HARDENED Ni-Ti ALLOY, by M. M. Dawance, D. H. Ben Israel, and M. E. Fine. [1964] [8]p. incl. diagrs. refs. (AFOSR-64-2101) (AF 49(638)524) AD 451347
                                                    Unclassified

Also published in Acta Metall., v. 12: 705-712, June 1964.

The effect of deformation on the Curie temperature of a quenched and aged alloy of Ni-10. 3 at. -% Ti, 0. 6 at. -%Al was determined. For short aging times (5 hr) at 525°C there is a large decrease in Curie temperature on deformation, but for long aging times (200 hr) the Curie temperature is little affected by deformation. This result indicates that at first the decomposition product is a fluctuation of composition in the solid solution but later a discrete nonferromagnetic precipitate forms. The former qualitatively confirms the recent theories of decomposition which begins inside the spinodal.

1901

Northwestern U. Dept. of Materials Science, Evanston, Ill.

PRECIPITATE AND DISPERSION HARDENING OF

CRYSTALLINE SOLIDS, by M. E. Fine. [1963] [21]p. incl. diagrs. table, refs. (AFOSR-64-2525) (AF 49(638)524) AD 453801   Unclassified

Also published in Proc. Conf. on the Relation between Structure and Strength in Metals and Alloys, Teddington, Middlesex (Gt. Brit.), Jan. 7-9, 1963, p. 299-320.

It should first of all be emphasized that precipitate and dispersion hardening (that is, particle hardening) of crystalline solids does not arise from a single origin. There are a large number of possible sources of hardening and in most specific instances more than one is important. It is very difficult to ascribe quantitatively the hardening to specific sources in specific alloys at the present time. The plan of this paper is to give first a general outline of the important considerations, then take up some of them in more detail, discussing specific alloys.

1902

Northwestern U. [Dept. of Materials Science] Evanston, Ill.

THEORETICAL ANALYSIS OF THE EFFECT OF SUBSTITUTIONAL POINT DEFECTS ON THERMAL EXPANSION, by T. J. Hughes and J. O. Brittain. [1964] [4]p. (AFOSR-64-2527) (AF 49(638)780) AD 453825
                                                    Unclassified

Also published in Phys. Rev., v. 135: A1738-A1741, Sept. 14, 1964.

A thermal-expansion theory has been derived for primary solid-solution binary alloys treating the solute atoms as elastic spheres imbedded in an infinite elastic continuum and considering the interactions between the thermal expansion of these point defects and the matrix. The theory predicts that the thermal-expansion coefficient of the alloy can be determined from the thermal-expansion coefficients and the elastic constants of the constituents, and from the atomic volume of the solute atom. The theory is verified for various alloys in the temperature and composition ranges consistent with the assumption of the theory; i. e., for temperature and composition ranges which obey the Grueneisen law of thermal expansion for the pure components and for the alloy.

1903

Northwestern U. [Dept. of Materials Science] Evanston, Ill.

STRAIN HARDENING AND STRESS DEPENDENCY OF DISLOCATION VELOCITY IN ALPHA-IRON ALLOYS WITH A DISPERSED PHASE, by F. Felberbauer, E. P. Lautenschlager, and J. O. Brittain. [1964] 8p. (AFOSR-65-0162) (AF 49(638)780) AD 611493
                                                    Unclassified

Also published in Trans. Metall. Soc. AIME, v. 230: 1596-1603, Dec. 1964.

Experiments were made in alpha-iron specimens with controlled amounts of carbon and/or Al_2O_3. They were tested at various temperatures between 195 and 373°K under a variety of conditions of concentration, strain rate, and quench aging. The resulting yield strength, flow strength, and strain hardening increased with addition of Al_2O_3. The parameter m, measured from changes in strain rate, was used to describe the stress dependency of the dislocation velocity. m was found to increase with additions of Al_2O_3, increasing carbon in solution, and with increasing temperature. When applied to a recent model for yielding based upon dislocation multiplication and velocity characterisitics, the values of m alone did not successfully predict yielding for the materials of this investigation. but had to be adjusted with a consideration of the number of unlocked dislocations nucleated heterogeneously at discontinuities or inclusions. The change of yield strength with Al_2O_3 interparticle spacing appeared to obey a theory of Orowan.

1904

Northwestern U. Dept. of Materials Science, Evanston, Ill.

SOLID SOLUTION AND PRECIPITATION HARDENING IN Mg-Fe-O ALLOYS, by G. W. Groves and M. E. Fine. [1964] [7]p. incl. illus. diagrs. refs. (AFOSR-65-0785) (AF AFOSR-63-327) AD 616046
Unclassified

Also published in Jour. Appl. Phys., v. 35: 3587-3593, Dec. 1964.

Iron was introduced into single crystals of MgO by diffusion to produce thin homogeneous slices of alloy crystals containing up to about 4% Fe/(Mg+Fe). When the iron is present as Fe^{2+} the MgO crystal is not appreciably strengthened but 1% Fe^{3+} retained in solution by quenching approximately doubles the flow stress of the original crystal. The strengthening due to Fe^{3+} can be enhanced slightly by aging the crystal in air at 700° to 1000°C. This causes a precipitate of magnesioferrite to form as octahedra which are perfectly oriented within the MgO, the faces of the octahedra being parallel to {111} in the MgO. The fracture process is not greatly affected by the presence of this coherent precipitate. Continued aging reduces the strength and coarsens the precipitate without change in shape over a size range of 100A to 1μ.

1905

Northwestern U. Dept. of Mathematics, Evanston, Ill.

FLUCTUATION AND MULTIDIMENSIONAL PROBLEMS, by M. Dwass. Final rept. Mar. 1, 1965, 1p. (AFOSR-65-0552) (AF AFOSR-63-67)   Unclassified

This report lists the research which was done wholly or in part under the grant. Three reports were published in Ann. Math. Stat. Citations are given for these articles. Two reports are listed which will be published.

1906

Northwestern U. [Dept. of Physics] Evanston, Ill.

THE VISCOSITY OF ARGON, KRYPTON, AND XENON IN THE DENSE GASEOUS REGION, by E. G. Reynes and G. Thodos. [1964] [14]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1477) (AF AFOSR-63-45) AD 623198
Unclassified

Also published in Physica, v. 30: 1529-1542, 1964.

The effect of pressure on the viscosity of argon, krypton, and xenon has been established experimentally for pressures ranging up to 820 atm at 100, 150, and 200°C. For xenon additional measurements were carried out at 50°C. These measurements were made using an unsteady flow transpiration type capillary viscometer, whose basic dimensions were accounted for in order to operate it in an absolute manner. The residual viscosities resulting from these measurements were normalized with the parameter, $\xi = T_c^{1/6} M^{1/2} P_c^{2/3}$, to produce values of $(\mu - \mu^*)\xi$, which correlated with the corresponding reduced density, ρR, to produce a single continuous function for these three monatomic gases.

1907

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

A SPECTROSCOPIC STUDY OF THE THERMODYNAMIC STATE OF ARGON IN A CONICAL ELECTROMAGNETIC SHOCK TUBE, by J. A. Thornton and A. B. Cambel. [1964] [22]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0297) (AF AFOSR-62-307)
Unclassified

Also published in Jour. Quant. Spectros. Radiative Transfer, v. 4: 539-557, 1964.

This paper describes time resolved spectroscopic experiments in which the average thermodynamic state across the diameter of the accelerated argon plasma generated in a 3 in. diam conical type electromagnetic shock tube was determined at ambient pressure of 50 μ, 300 μ, and 1 mm Hg and at positions of 15·25 cm, 20 cm and 35·5 cm downstream from the ring electrode. Luminous front velocities ranged from 0·25 to 1 cm/μsec, temperatures from 13,000 to 18,000°K and peak electron densities from 10^{16} to 10^{17} cm^{-3}. The data indicate complete thermodynamic equilibrium. In all tests the temperatures were significantly higher than those predicted by the shock equations assuming a cold gas ahead of the luminous front. Microwave transmission measurements indicate that the electron density ahead of the luminous front is less than 5×10^{10} cm^{-3}. It is concluded that luminosity of the kind observed is from the driver plasma or a mixture of the driver

and driven plasmas, depending on the ambient pressure, and that the thermodynamic state of the accelerated plasma must therefore be determined experimentally. (Contractor's abstract)

1908

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

GENERALIZED SELF-SIMILARITY AND SOLUTIONS FOR MAGNETOGASDYNAMIC FREE JETS, by W. F. Hug. 1964, 80p. (Rept. no. NU-GDL-B-3-64) (AF AFOSR-62-307) AD 608170   Unclassified

The method of self-similar solutions has been shown to be a powerful analytical tool in the investigation of the mixing region of a laminar two-dimensional magnetogasdynamic jet which is freely expanding into an unbounded stagnant region. The general conditions under which self-similitude can be expected are investigated. Two undocumented solutions are shown to be available: (1) The subsonic gasdynamic free jet with non-unitary Prandtl number and a viscisoty which is proportional to the square root of temperature. Solution to this problem is given in closed form in the 'incompressible' von Mises solution plane with a transformation back to physical coordinates accomplished by numerical integration. (2) The subsonic magnetogasdynamic free jet with non-unitary Prandtl number, a viscosity which is proportional to the square root of temperature, and an electrical conductivity which is proportional to the square root of the temperature cubed.

1909

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

MICROWAVE DIAGNOSTICS OF ARC HEATED ARGON PLASMA FLOWS, by R. C. Warder, Jr. Apr. 1963, 238p. (Rept. no. NU-GDL-B-L-63) (AF AFOSR-62-307) AD 602543   Unclassified

An experimental investigation of the electrical properties of arc-heated plasma flows was conducted using microwave diagnostic techniques. The basic theory underlying the propagation of electromagnetic waves in isotropic and anisotropic plasmas necessary for the interpretation of the microwave measurements is presented. Phase shift and attenuation measurements at 78 and 85.3 kmc were made to determine the electron density and electron collision frequency of the plasma flows. The electron densities which were determined experimentally agree quite well for the two operating frequencies. Comparison of the experimental electron densities with theoretical predictions indicates that the plasma flow is not in equilibrium. The attenuation measurements at the two frequencies agree qualitatively; however, the electron collision frequencies derived from these measurements do not agree quantitatively. Comparison with theoretical predictions indicates that electron-ion collisions are the predominant dissipative mechanism.

1910

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

TWO-DIMENSIONAL HEATED JET WITH AN ARBITRARY PRANDTL NUMBER AND MAGNETOGASDYNAMIC FREE JET, by D. C. Smith and A. B. Cambel. Oct. 1964 [57]p. incl. refs. (Rept. no. B-2-64) (AFOSR-65-0926) (AF AFOSR-63-329)
Unclassified

Most of the existing solutions to the free jet problem are restricted by assumptions of constant viscosity, a unitary Prandtl number and incompressible fluids. The solution of the 2-dimensional, laminar jet of a compressible fluid with an arbitrary Prandtl number is presented for subsonic flow. A solution is also obtained for any Mach number flow for a Prandtl number of 1. The laminar, compressible, two-dimensional jet of an electrically conducting fluid with an applied transverse magnetic field is solved by a perturbation technique. The perturbation parameter is the non-dimensional ratio of the magnetic force to the inertia force of the jet. The velocity and temperature distributions are found in closed form to first order in the perturbation parameter. The velocity profiles are also obtained, to first order, for an electric field applied in a direction normal to both the magnetic field and the axial direction. The solution is valid for an electric field that is the same order of magnitude as the v x B force.

1911

Northwestern U. [Information-Processing and Control Systems Lab.] Evanston, Ill.

OPTIMUM DESIGN OF NONLINEAR SAMPLED-DATA CONTROL SYSTEMS, by T. Meksawan and G. J. Murphy. [1963] [5]p. (AFOSR-J1206) (AF AFOSR-63-270) AD 423121   Unclassified

Also published in Regelungstechnik, v. 7: 295-299, Jan. 11, 1963.

A simple and systematic procedure is presented for the design of certain time-optimal nonlinear sampled-data control systems. The method leads to the design of a digital compensating network to fulfill an optimal performance requirement. The synthesis technique presented is applicable to an nth-order linear system with a zero-memory nonlinear element cascade, provided that the linear system is completely controllable.

1912

Northwestern U. Information-Processing and Control Systems Lab., Evanston, Ill.

OPTIMAL SYNTHESIS OF LINEAR PULSE-WIDTH-MODULATED COMPUTER-CONTROLLED SYSTEMS, by G. J. Murphy and T. Meksawan. [1964] [12]p. incl. diagrs. table, refs. (AFOSR-64-0970) (AF AFOSR-63-270)   Unclassified

Also published in Jour. Franklin Inst., v. 277: 128-139, Feb. 1964.

The purpose of this paper is to present a technique for optimal synthesis of linear control systems with pulse-width modulation. The criterion of system performance is a quadratic index, which is taken in an illustrative example to be the sum of the squares of the error at sampling instants for the case in which the input to the system is a step function. The technique, which is based on the state-variable concept and on dynamic programming, leads to the determination of a computer program for calculating the optimum sequence of signals to be applied to the input of the pulse-width modulator. (Contractor's abstract)

1913

Northwestern U. Information-Processing and Control Systems Lab., Evanston, Ill.

TIME-OPTIMAL PULSE-WIDTH CONTROL OF LINEAR SYSTEMS, by G. J. Murphy and T. Meksawan. [1964] [5]p. incl. diagrs. tables. (AFOSR-64-2323) (AF AFOSR-63-270) AD 452326   Unclassified

Also published in Proc. Nat'l. Electronics Conf., v. 20: 1964.

This paper presents a technique for the synthesis of linear systems with pulse-width modulation to fulfill a time-optimal performance criterion. The synthesis procedure is developed by use of the state-transition method of representation of performance of the system. By the use of the design procedure presented, a pulsed-data network can be designed to produce the time-optimal deadbeat response of the system to a specified deterministic input, which is chosen to be a step function in the illustrative example.

1914

Northwestern U. Information-Processing and Control Systems Lab., Evanston, Ill.

A STABILITY CRITERION FOR PULSE-WIDTH-MODULATED FEEDBACK CONTROL SYSTEMS, by G. J. Murphy and S. H. Wu. [1964] [8]p. incl. diagrs. refs. (AFOSR-65-0627) (AF AFOSR-63-270) AD 614489   Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-9: 434-441, Oct. 1964.

Aizerman's method for investigating asymptotic stability in the large, which was extended by Kodama to encompass nonlinear sampled-data systems, is further extended in this paper. The concept is developed with specific reference to pulse-width-modulated feedback systems, but the method is applicable to a more general class of nonlinear discrete-time systems. The significant difference between the class of systems treated here and the class treated by Kodama is that in the latter class the nonlinear factor is a scalar, whereas in the former, it is a vector. This difference is not trivial; the presence of the vector nonlinearity requires a substantial change in the procedure for determining the range of a parameter over which the system is asymptotically stable in the large. By application of

the method presented in this paper, one can obtain a sufficient condition for asymptotic stability in the large of pulse-width-modulated feedback systems. The method is not limited to cases in which the poles of the transfer function of the plant are real and/or simple and the result obtained, at least in those cases investigated to date, is not highly conservative.

1915

Northwestern U. [Technological Inst.] Evanston, Ill.

THERMOELASTIC DISSIPATION IN HIGH-FREQUENCY VIBRATIONS OF CRYSTAL PLATES, by J. Tasi and G. Herrmann. [1964] [9]p. incl. diagrs. (AFOSR-64-1027) (In cooperation with Columbia U. AF 49(638)430) (AF AFOSR-62-465) AD 440980   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 100-110, Jan. 1964.

A system of approximate, two-dimensional equations is derived for the thermoelastic response of crystal plates. The equations take into account the coupling of thickness-shear, flexural, and extensional motion with symmetric and antisymmetric thermal modes. The thermoelastic dissipation predicted at high frequencies by the approximate theory is compared with a three-dimensional solution, using the free vibrations of AT⁻ cut quartz plate as a basis of comparison. (Contractor's abstract)

1916

Northwestern U. Technological Inst., Evanston, Ill.

INSTRUMENTATION TO STUDY THE DYNAMIC BEHAVIOR OF CYLINDRICAL SHELL INCLUDING THERMAL EFFECTS, by G. Hermann and J. F. Fleming. 1963, 11p. (AFOSR-64-0112) (AF AFOSR-63-100) AD 430674   Unclassified

Presented at Symposium on Measurement and Evaluation of Dynamic Effects and Vibrations of Constructions, Budapest, 1963.

The paper describes the instrumentation which was developed and is being used to study the dynamic response of cylindrical shells at room and at elevated temperatures, and which is readily usable for simpler structural elements, such as beams, slabs, etc. This instrumentation permits the excitation of numerous principal modes of free vibration of a shell subjected to various mechanical and thermal initial stresses, and the determination of the mode shape, natural frequency and damping properties associated with each principal mode. The salient features and operating characteristics of the various components of the equipment used are described, with particular emphasis on the behavior at elevated temperatures. The possibilities are discussed of adapting the present equipment to more complicated structural elements, such as conical shells, and to more complicated dynamic phenomena, such as mechanical and thermal impact loading.

1917

Northwestern U. Technological Inst., Evanston, Ili.

ON THE STABILITY OF ELASTIC SYSTEMS SUB-
JECTED TO NONCONSERVATIVE FORCES, by G.
Herrmann and R. W. Bungay. [1964] [6]p. incl.
diagrs. refs. (AFOSR-64-2240) (AF AFOSR-63-100)
AD 452400   Unclassified

Presented at Summer Conf. of the Applied Mechanics
Div., American Society of Mechanical Engineers,
Boulder, Colo., June 9-11, 1964.

Free motions of a linear elastic, nondissipative, two-
degree-of-freedom system, subjected to a static non-
conservative loading, are analyzed with the aim of
studying the connection between the two instability
mechanisms known to be possible for such systems.
An independent parameter is introduced to reflect the
ratio of the conservative and nonconservative compo-
nents of the loading. Depending on the value of this
parameter, instability is found to occur for compressive
loadings by divergence, flutter, or by both with mul-
tiple stable and unstable ranges of the load. In the lat-
ter case either type of instability may be the first to
occur with increasing load. For a range of the parame-
ter, divergence is found to occur for tensile loads.
Regardless of the nonconservativeness of the system,
the critical loads for divergence can always be deter-
mined by the Euler method. The critical loads for
flutter can be determined, of course, by the kinetic
method alone. (Contractor's abstract)

1918

Northwestern U. Technological Inst., Evanston, Ill.

ON SECOND-ORDER THERMOELASTIC EFFECTS,
by G. Herrmann. [1964] [10]p. (AFOSR-65-0558)
(AF AFOSR-63-100) AD 614749   Unclassified

Also published in Zeitsch. Angew. Math. und Phys.,
v. 15: 253-262, 1964.

It is of interest in second-order thermoelasticity to
determine the thermal effects accompanying an iso-
choric deformation, a state of pure shear strain, a
state of pure shear stress, and also to find the states
of strain and stress associated with isothermal shear.
In this paper Brot's second-order theory of elasticity

is extended to include thermal effects. Expressions
for entropy and temperature change in an adiabatic
deformation are derived, following Biot's presentation
of linear thermoelasticity, which indicate that the
thermal second-order effects are governed primarily
by the product formed by the temperature rate of change
of the shear modulus and the second invariant of the
strain deviator.

1919

Northwestern U. Technological Inst., Evanston, Ill.

[DYNAMIC BEHAVIOR OF SOLIDS], by G. Herrmann.
Final scientific rept. Oct. 1, 1963-Sept. 30, 1964, 16p.
incl. refs. (AFOSR-65-0460) (AF AFOSR-64-100)
                                      Unclassified

Analytical and experimental studies were conducted in-
volving thermal effects in thin-walled shells, effects of
moving and rapidly applied loads, and effects of struc-
tural interaction between thin shells and other contact-
ing media. The results have application to the dynamic
response and stability of structural elements and struc-
tural systems used for aerospace vehicles of various
types.

1920

Northwestern U. Technological Inst., Evanston, Ill.

SHELL BUCKLING AND NONCONSERVATIVE
FORCES, by G. Herrmann and R. W. Bungay. [1964]
[1]p. (AFOSR-65-0560) (AF AFOSR-64-100) AD 615186
                                      Unclassified

Also published in AIAA Jour., v. 2: 1165-1166, June
1964.

In a former note it was advanced that the wide scatter
of observed buckling loads of pressurized shells
might be attributed to the presence of nonconservative
generalized forces. In this paper the theory is re-
futed as being not applicable in the sense envisaged
by the author and having only limited validity. Prob-
lems in static and dynamic loading are considered.

1921

Ohio State U. [Research Foundation] Dept. of
Aeronautical and Astronautical Engineering, Columbus.

FORMATION OF DETONATION WAVES IN COMBUS-
TIBLE GASEOUS MIXTURES, by L. E. Bollinger.
Apr. 1964, 48p. incl. refs. (WSS/CI Paper no. 64-15)
(AFOSR-65-2205) (AF AFOSR-63-203) AD 625489
Unclassified

Presented at Spring Meeting of the Combustion
Institute, Western States Section, Stanford U., Calif.,
Apr. 1964.

A review is presented of selected papers and reports
which pertain to the formation of detonation waves in
combustible gaseous mixtures. During the past decade,
extensive progress has been made in elucidating the
mechanism, and the parameters that influence it, by
which a deflagration wave accelerates and forms a
stable detonation. Propulsion devices which employ
stabilized detonation waves are being studied; thus, it
is necessary to learn more about the transition process.
Many investigators believe that a better understanding
of the process of detonation-wave formation will assist
in the exploration and eventual control of combustion
instability in rocket engines. (Contractor's abstract)

1922

Ohio State U. [Research Foundation. Dept. of Chemistry]
Columbus.

THE SYNTHESIS OF 3-ETHYL-4-METHYLPHENOL
AND 3-ISOPROPYL-4-METHYLPHENOL FROM 3,4-
DIMETHYLPHENOL VIA TRICHLOROMETHYL INTER-
MEDIATES, by M. S. Newman and F. Bayerlein.
[1963] [3]p. incl. diagrs. refs. (AFOSR-557) (AF 49-
(638)277) AD 429295   Unclassified

Also published in Jour. Org. Chem., v. 28: 2804-
2806, Oct. 1963.

On refluxing solutions of 3,4-dimethyl-4-trichloro-
methyl-2,5-cyclohexadienone (I) in the acetic anhydride
containing an acid, rearrangement to the acetate of 4-
methyl-3(β,β,β-trichlorethyl)phenol (II) occurs in high
yield. Treatment of II with piperidine yields 4-methyl-
3-(β,β-dichlorovinyl)phenol (III) which on hydrogenation
is converted into 3-ethyl-4-methylphenol (IV). Conden-
sation of IV with carbon tetrachloride (aluminum
chloride) affords 3-ethyl-4-methyl-4-trichloromethyl-
2,5-cyclohexadienone (V) which may be converted into
4-methyl-3-isopropylphenol (VI) by a series of reactions
analogous to those by which II is converted into IV.
(Contractor's abstract)

1923

Ohio State U. Research Foundation. Dept. of Chemistry,
Columbus.

SYNTHESIS AND REARRANGEMENT OF COMPOUNDS
CONTAINING TRIHALOMETHYL GROUPS, by M. S.

Newman. Final rept. July 1, 1958-Dec. 31, 1962.
Apr. 16, 1963, 6p. incl. diagrs. (AFOSR-4874)
(AF 49(638)277) AD 414030   Unclassified

Several new reactions that have been discovered are
discussed. These relate mainly to the migrations of the
trichloromethyl group so that it can now be predicted
with reasonable accuracy what reactions will occur with
cyclohexadienone type compounds which contain the
trichloromethyl group.

1924

Ohio State U. [Research Foundation. Dept. of Chemistry]
Columbus.

FURTHER STUDIES ON 2,5-CYCLOHEXADIENONES
CONTAINING THE TRICHLOROMETHYL GROUP, by M.
S. Newman and J. A. Eberwein. [1964] [4]p. incl.
diagrs. table, refs. (AFOSR-64-1947) (AF 49(638)277)
AD 450513   Unclassified

Also published in Jour. Org. Chem., v. 29: 2516-
2519, Sept. 1964.

The products of reactions of 3,4-dimethyl-4-trichloro-
methyl-2,5-cyclohexadienone with phenyl-, methyl-,
and ethoxyethynylmagnesium bromide and of 4-trichloro-
methyl-2,4,5-trimethyl-2,5-cyclohexadienone with
ethoxyethynylmagnesium bromide are described. In no
case could the expected carbinol be isolated, since re-
arrangements occurred under mild conditions. In all
cases 1,3- or 1,5-migration of the trichloromethyl
groups occurred. (Contractor's abstract)

1925

Ohio State U. Research Foundation. Dept. of Physics [and
Astronomy] Columbus.

RESEARCH ON ROTATING RF FIELD PLASMA, by M.
L. Pool. Final rept. Nov. 1, 1962-Sept. 30, 1964.
Oct. 1964, 1v. incl. illus. diagrs. tables, refs. (Rept.
no. 1566) (AFOSR-64-2227) (AF AFOSR-63-202)
Unclassified

Three-phase ion-cyclotron frequency power input to a
magnetic bottle has produced a plasma over a wide
range of hydrogen and deuterium pressures. Electrons
and ions which escape from the ends of the bottle have
energies in the neighborhood of 0.1 kev. A pulsed 9400
mc input peak power of 30 kw created x-rays in the
neighborhood of 20 kev. Hard superconductors of Nb and
of Nb-Zr were shown to be superconducting at the ion-
cyclotron frequency of 4.2 mc. A Michelson type of
microwave diagnostic assembly at 27.5 Gc frequency
was made operative for measuring electron densities
as low as 10^{10}/cm^{-3}. Two-phase ion-cyclotron fre-
quency power input to the magnetic bottle has produced
a plasma. A 30-joule diagnostic laser was installed and
operated for measuring electron densities in the region
of 10^{13}/cm^{-3}. The various diagnostic data indicate that
(a) a higher powered two-phase ion-cyclotron oscillator
and (b) a stronger magnetic bottle field are needed for
achieving a significant increase in the ion density, the
ion temperature, and the ion retainment time.

1926

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

TOWARD A TAXONOMY OF ORGANIZATIONS, by N. J. Johnson. 1963, 239p. (AFOSR-5361) (AF 49(638)-447) AD 426089   Unclassified

This exploratory study presents an attempt to develop a taxonomy of organizations. The evidence from this study seems to indicate that the basic approach used by the biologist can fruitfully be used in developing a classification system for organizations. Data were collected on 99 characteristics. The sample consisted of 75 organizations which were selected so as to maximize heterogeneity. The data were collected by means of tape-recorded interviews with the top executives of the organizations. The interviews were transcribed verbatim and content analyzed. The evidence from this study seems to indicate that the basic approach was fruitful.

1927

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

THE SIZE OF THE SUPPORTIVE COMPONENT IN ORGANIZATIONS: A MULTI-ORGANIZATIONAL ANALYSIS, by E. Haas, R. H. Hall, and N. J. Johnson. 1963, 9p. (AFOSR-64-0257) (AF 49(638)447) AD 432525   Unclassified

In an analysis of thirty organizations of various types, the authors examine the relation of varying size of the supportive component to other organizational characteristics such as total size, age, number of operating sites, diversification of activities performed, and type of organizational function. Total organizational size and number of locations appear to be related to size of supportive component but they vary inversely.

1928

Ohio State U. Research Foundation. Dept. of Psychology, Columbus.

PERSONALITY FACTORS IN MOTIVATION, by J. B. Rotter. Final rept. Dec. 2, 1963, 16p. incl. refs. (Rept. no. 1007) (AFOSR-J1371) (AF 49(638)741) AD 426514   Unclassified

This investigation is concerned with two general areas of study. One has to do with the general conditions which make for a perception of external control, chance, fate, etc., and the conditions which lead the individual to seek reinforcements as contingent upon himself. In this area we are also interested in the characteristics of the individual's behavior or changes in him as a result of such a perception, as well as the conditions which produce such a perception. The second broad area of individual differences. Given the same situation one individual may interpret what happens to him as determined by luck or fate, and another may interpret it as a result of his own actions. Individual differences in such perception might have important implications for problems of efficiency of learning, social behavior, adjustment and psychotherapy, social attitudes, and all interpersonal behavior. (Contractor's abstract, modified)

1929

Oklahoma State U., Stillwater.

PHOTOEFFECTS AND RELATED PROPERTIES OF SEMICONDUCTING DIAMONDS, by C. Johnson, H. Stein and others. [1964] [10]p. (AFOSR-64-2094) (AF 18(603)40) AD 451342   Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 827-836, 1964.

A number of properties of natural semiconducting diamonds have been investigated. The studies were concerned with the optical transmission, photoconductivity, mobility and activation energies of carriers, also the lifetime and trapping of carriers. Optical transmission as a function of the temperature was measured. Optical absorption characteristic of type IIb diamond was observed. Photoconductivity was determined as a function of excitation wavelength, intensity of illumination, temperature and electric field strength. A number of maxima in photoconductivity occur in the visible and near infrared ranges which are not resolved in the optical transmission measurements.

1930

Oklahoma State U. Dept. of Chemistry, Stillwater.

NUCLEOPHILIC DISPLACEMENT REACTIONS ON ORGANOPHOSPHORUS ESTERS BY GRIGNARD REAGENTS. I, by K. D. Berlin, T. H. Austin, and K. L. Stone. [1964] [4]p. incl. table, refs. (AFOSR-64-1509) (AF AFOSR-63-132) AD 446110   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 1787-1790, May 5, 1964.

Careful examination by gas chromatography of the various reaction mixtures from the condensation of trimethyl phosphite with the phenyl Grignard reagent under nitrogen revealed only trivalent phosphorus compounds. In no instance were products detected which suggested the occurrence of a Michaelis-Arbuzov rearrangement; thus, previously reported data are repudiated. A mechanism is postulated for the step-wise displacement of methoxy groups in which the initial Grignard-phosphite complex is attacked by the Grignard reagent. With a 1:1 ratio of phosphite to Grignard reagent, considerable methyl diphenylphosphinite was observed; this is in contrast to other reports. An explanation of the observed products is postulated to involve equilibria between complexes of Grignard reagent and intermediate esters. (Contractor's abstract)

1931

Oklahoma State U. Dept. of Chemistry, Stillwater.

UNSYMMETRICAL TERTIARY PHOSPHINE OXIDES
FROM DIPHENYL PHENYLPHOSPHONATE; A CON-
VENIENT SYNTHESIS, by K. D. Berlin and M.
Nagabhushanam. [1964] [2]p. incl. table, refs.
(AFOSR-64-1510) (AF AFOSR-63-132) AD 446118
Unclassified

Also published in Chem. and Indus. (London), June 6,
1964, p. 974-975.

In view of recent developments concerning the cleavage
of triphenylphosphine oxide by lithium reagents to give
lithium intermediates which are useful in the synthesis
of organophosphorus compounds, the availability of
unsymmetrical tertiary phosphine oxides of the type
$ArP(O)R'_2$ appears important. From current reviews
it is apparent that although several synthetic routes
exist for this class of phosphine oxides, no one method
appears of general utility and the yields reported are
modest. Phosphonates have been suggested as pre-
cursors via reactions with Grignard reagents but a
systematic study could not be found. Diphenyl phenyl-
phosphonate has now been revealed as a convenient
reagent for the preparation of phenyl-substituted phos-
phine oxides. Addition of the compound to a 1 mol ex-
cess of the appropriate Grignard reagent in ether-
benzene gave excellent yields of a variety of unsymmet-
rical phosphine oxides. (Contractor's abstract)

1932

Oklahoma State U. [Dept. of Chemistry] Stillwater.

NUCLEOPHILIC DISPLACEMENT REACTIONS ON
PHOSPHORUS HALIDES AND ESTERS BY GRIGNARD
AND LITHIUM REAGENTS, by K. D. Berlin, T. H.
Austin and others. [1964] [39]p. incl. refs. (AFOSR-
64-1949) (AF AFOSR-63-132) AD 450507
Unclassified

Also published in Topics in Phosphorus Chem., v. 1:
17-55, 1964.

The contents of this report are: Reactions of trivalent
phosphorus halides with Grignard reagents; Reactions
of tetravalent phosphorus halides with Grignard rea-
gents; Reactions of pentavalent phosphorus halides with
Grignard and lithium reagents; Reactions of trivalent
phosphorus esters with Grignard reagents; Reactions
of tetravalent phosphorus esters with Grignard rea-
gents; Reactions of organophosphorus halides and esters
with lithium reagents; Reactions of sulfur-containing
organophosphorus halides and esters with Grignard
and lithium reagents.

1933

Oklahoma State U. [Dept. of Physics] Stillwater.

THEORY OF ELECTRON CAPTURE IN H^+-H
COLLISIONS, by B. Roth. Final rept. Sept. 1963, 21p.
incl. diagr. table. (AFOSR-J1309) (AF AFOSR-63-
31) AD 424236 Unclassified

Also published in Phys. Rev., v. 133: A1257-A1262,
Mar. 2, 1964

The theory of electron capture in H^+-H collisions at
kv energies is developed. A strong coupling is assumed
between the electron ground states in the target and
scattered atoms. The method depends upon an approxi-
mate which amounts to neglecting terms of order K^{-1}
compared to 1, where K is the wave number in atomic
units for the collision of the two protons. Calculations
were made for lab energies from 0.6 to 50 kev and the
results compare favorably with the experimental results
of Lockwood and Everhart. The center of mass correc-
tion accounts for the damping of resonances and other-
wise produces a considerable effect. The method is
applied to developing a formula for the relative proba-
bility for capture into an excited state. It is estimated
that this probability is small. (Contractor's abstract)

1934

Oklahoma U. [Dept. of Mathematics] Norman.

OPTIMAL PROGRAMS FOR AN ASCENDING MISSILE,
by G. M. Ewing and W. R. Haseltine. [1964] [23]p.
(AFOSR-64-2488) (AF AFOSR-63-211) AD 453782
Unclassified

Also published in SIAM Jour. Control, Series A, v. 2:
66-88, 1964.

In 1919, R. H. Goddard proposed the problem of
minimizing the mass of a given propellant required to
transfer a rocket along a vertical path from rest on the
earth to an assigned maximal height. He identified this
as an unsolved problem of the calculus of variations but
attempted neither a solution nor a precise formulation.
Although this problem in one version or another, has
interested many writers, no adequate treatment of any
version has been published insofar as the present authors
are aware. The object here is to give one.

1935

Oklahoma U. [Dept. of Physics] Norman.

DIRECT MEASUREMENTS OF THE LIFETIMES OF
EXCITED STATES OF NEUTRAL HELIUM, by R. G.
Fowler, T. M. Holzberlein and others. [1964] [5]p.
(AFOSR-64-2467) (AF 49(638)629 and AF AFOSR-62-
378) AD 453959; AD 451825 Unclassified

Also published in Proc. Phys. Soc. (London), v. 84:
539-543, 1964.

A straightforward method of measuring lifetimes of He
I excited states, by following the decay of excited states,
has yielded generally good agreement with other methods
and with theory. Additional information about the im-
portance of indirect population processes is provided by
the new technique. In the 3D system a fraction ranging
from 75% to nearly 100% is contributed indirectly.

1936

Oklahoma U. Dept. of Physics, Norman.

DIRECT MEASUREMENT OF ATOMIC LIFETIMES:
HELIUM, by T. M. Holzberlein. [1964] [6]p. incl.
illus. diagrs. table, refs. (AFOSR-64-2468) (AF 49-
(638)639 and AF AFOSR-62-378) AD 450245
Unclassified

Also published in Rev. Scient. Instr., v. 35: 1041-
1045, Aug. 1964.

A complete system for direct observation of decay of
excited states is described. It comprises an inverted
triode excitation tube with coaxial symmetry, capable
of responding to an electrical cutoff with a risetime of
about 10 nsec. Tests in helium have shown that in its
present form it can give reliable lifetimes at least as
small as 30 nsec. (Contractor's abstract)

1937

Oklahoma U. Dept. of Physics, Norman.

INELASTIC ELECTRON-ATOM COLLISIONS UNDER
NEAR-RESONANCE CONDITIONS: ANALYSIS OF
TRANSITIONS INVOLVING STRONG COUPLING, by
N. F. Lane and C. C. Lin. [1964] [15]p. incl. diagrs.
tables, refs. (AFOSR-64-1982) (AF AFOSR-63-252)
AD 452310   Unclassified

Also published in Phys. Rev., v. 133: A947-A961,
Feb. 17, 1964.

A method has been devised to calculate the cross sec-
tions of inelastic electron-atom collisions under near-
resonance conditions. This method (referred to as the
method of resonance distortion) consists of solving the
limiting exact-resonance problem as the zeroth-order
approximation and using this solution to obtain the first-
order solution by an iteration procedure, and is par-
ticularly suitable for treating optically allowed transi-
tions produced by electron impact where the coupling
between the initial and final states is strong and of long-
range type. Application of this method has been made
to a schematic model with an isotropic inverse-square
interaction potential and to the problem of electron-
atom collisions with ns → np transition. The general
results indicate that (1) for weak coupling the collision
strengths calculated by the resonance-distortion scheme
reduce to those calculated by the method of distorted
waves, (2) the resonance-distortion method and Seaton's
BП method give nearly equal partial cross sections for
large l, and (3) a very low l, the BП partial cross sec-
tions are substantially larger than those determined
from the resonance-distortion method. (Contractor's
abstract, in part)

1938

Oklahoma U. Dept. of Physics, Norman.

ABSOLUTE ELECTRON EXCITATION FUNCTIONS OF

HELIUM AND THEIR PRESSURE DEPENDENCE, by
R. M. St. John and C. C. Lin. [1964] [6]p. incl.
diagrs. tables. (AFOSR-64-1983) (AF AFOSR-63-252)
AD 452308   Unclassified

Also published in Atomic Collision Processes; Proc.
Third Intern'l. Conf. on the Physics of Electronic
and Atomic Collisions, University Coll., London (Gt.
Brit.) (July 22-26, 1963), ed. by M. R. C. McDowell.
Amsterdam, North-Holland Publishing Co., 1964,
p. 163-168.

Absolute values of cross sections for excitation of
helium atoms by electron impact have been determined
for electron energies from 29 to 500 ev. Excitation to
the 4^1S, 5^1S, 6^1S, 3^1P, 4^1P, 4^1D, 5^1D, 6^1D, 4^3S, 5^3S,
3^3P, 3^3D, 4^3D, 5^3D and the 6^3D states was observed.
Helium pressures ranged from 4×10^{-4} to 2×10^{-1} torr.
Imprisonment of resonance radiation and excitation trans-
fer are not effective at lower pressures, but are at the
higher pressures, causing a gradual change in some of
the apparent excitation functions with pressure change.
All light intensity measurements were made by observa-
tion of radiation emitted at 90° relative to the electron
beam. This data was processed and recorded by an
electronic, continuous readout system. Corrections for
polarization of the emitted light are made for the 3^1P
case by the use of published helium polarization data.
(Contractor's abstract)

1939

Oklahoma U. [Dept. of Physics] Norman.

ABSOLUTE ELECTRON EXCITATION CROSS SECTIONS
OF HELIUM, by R. M. St. John, F. L. Miller, and
C. C. Lin. [1964] [10]p. (AFOSR-64-1984) (AF
AFOSR-63-252) AD 452307   Unclassified

Also published in Phys. Rev., v. 134: A888-A897,
May 18, 1964.

The absolute apparent electron excitation functions of
helium were measured for various excitation states at
pressures sufficiently low so that the effects of radiation
imprisonment and collisional excitation transfer can be
neglected. Corrections due to polarization of the radia-
tion and the cascading from the upper excited states
were applied to the experimental data and the true ex-
citation functions obtained. The peak values and the
shape of these excitation functions are compared with the
results reported from other laboratories. Generally
good agreement is found with the previous works where
the collisional excitation transfer was properly reduced
and allowance was made for the cascading effect.

1940

Oklahoma U. Dept. of Physics, Norman.

PRODUCTION OF EXCITATION AND IONIZATION IN
HELIUM BY SINGLE-ELECTRON IMPACT, by R. M.
St. John and C. C. Lin. [1964] [3]p. incl. diagrs.
(AFOSR-64-2309) (AF AFOSR-63-252) AD 451931
Unclassified

Also published in Jour. Chem. Phys., v. 41: 195-197, July 1, 1964.

The production of excited He$^+$ ions by single-electron impact collisions with ground-state helium atoms has been observed by the optical method. The absolute value of the cross section for the collision process yielding the n = 4 → n = 3 transitions in He$^+$ was determined for incident electron energies ranging from 60 to 470 ev. The excitation-ionization cross section exhibited a single broad maximum at 200 ev with an onset at 75 ev. The peak value of the cross section was 4.2×10^{-21} cm^2. Stepwise ionization and excitation was nowhere in evidence. The excitation-ionization function obtained at a number of gas pressures was independent of pressure. Light yield was proportional to the electron beam currents. Comparisons with previous experimental work and with theoretical calculations were made. (Contractor's abstract)

1941

Oklahoma U. Dept. of Physics, Norman.

ELECTRON-EXCITATION CROSS SECTIONS FOR HYDROGEN STATES WITH LARGE PRINCIPAL QUANTUM NUMBERS, by G. M. Cunningham and C. C. Lin. [1964] [2]p. incl. table. (AFOSR-65-0103) (AF AFOSR-63-252) AD 455853   Unclassified

Also published in Jour. Chem. Phys., v. 41: 3268-3269, Nov. 15, 1964.

Results of cross section calculations for the S, P, and D series of the hydrogen atom are reported for $3 \leq n \leq 30$. It is found that within the limits of the Born approximation, the cross-sections for each series are proportional to n^{-d} where d = 3.07, 3.02, and 2.98 for L = 0, 1, and 2 respectively.

1942

Optics Technology, Inc., Belmont, Calif.

DIFFRACTION AT DIELECTRIC AND CONDUCTING APERTURES OF A FEW-WAVELENGTH SIZE (Abstract), by J. J. Burke, N. S. Kapany, and K. Frame. [1963] [1]p. (AFOSR-J1310) (AF 49(638)1200)
                                                   Unclassified

Presented at 1963 Fall meeting of the Opt. Soc. of Amer., Chicago, Ill., Oct. 23-25, 1963.

Also published in Jour. Opt. Soc. Amer., v. 53: 1332, Nov. 1963.

This paper deals with a comprehensive theoretical and experimental study of diffraction at metallic and dielectric apertures of 31.7, 15.7, 7.5, 5.7, 5.0, 3.8, 2.3, and 2.12 λ size. The theoretical approach follows Keller's "Geometrical Theory of Diffraction." The model represents the slit as formed by opposing wedges with rounded ends. The far field at wide angles is the sum of two partial fields, one associated with diffracted rays, the other with reflected rays. Each partial field is evaluated numerically on a C.D.C. 1604 computer.

Experimental data are correlated with both the classical theory and the geometrical theory of diffraction.

1943

Optics Technology, Inc., Belmont, Calif.

ROLE OF FIBER OPTICS IN PHOTOGRAPHY, by N. S. Kapany. [1964] [4]p. incl. diagrs. (AFOSR-65-0445) (AF 49(638)1200) AD 612637   Unclassified

Presented at Internat'l. Commission for Optics Conf. on Photographic and Spectroscopic Optics, Tokyo and Kyoto (Japan), Sept. 1-8, 1964.

Fiber optics assemblies in the form of field flatteners, image dissectors, image intensifiers, FOCONS, and fiber coupling plates are described for use in various high speed, high resolution photographic systems and photoelectronic devices.

1944

Optics Technology, Inc., Belmont, Calif.

RADIATION CHARACTERISTICS OF OPTICAL WAVE-GUIDES (Abstract), by J. J. Burke, K. Frame, and N. S. Kapany. [1964] [1]p. (AFOSR-65-0451) (AF 49-(638)1200)   Unclassified

Presented at Forty-ninth annual meeting of the Opt. Soc. of Amer., New York, Oct. 6-9, 1964.

The radiation characteristics of isolated circular optical fibers capable of supporting only low-order dielectric waveguide modes are studied both theoretically and experimentally for several combinations of mode, wavelength, diameter, and fiber numerical aperture. Photographic and photoelectric measurements of the far-field intensities are compared with numerical predictions. For a cross-sectional intensity distribution in the mode pattern of the form $J_n^2(ur/a) + PJ_{n-2}^2(ur/a)$, the predicted Fraunhofer pattern has the approximate form: $(UJ_{n-1}^{(u)}J_n(x) - J_{n-1}(x)J_n^{(u)})^2/(x^2 - u^2)^2(x^2 + q^2)^2$, where J is the Bessel function of order n, $u(=ka\sin\theta_0)$ the customary diffraction parameter. θ_0 is the characteristic angle of the mode in the fiber of core refractive index N_1 and coating N_2. (Contractor's abstract, modified)

1945

Oregon State U., Corvallis.

ELASTIC DISPLACEMENT OF PRIMARY WAVES FROM EXPLOSIVE SOURCES, by J. W. Berg, Jr. and G. E. Papageorge. [1964] [13]p. (AF AFOSR-62-376) AD 444058   Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 947-959, June 1964.

Equations derived from Blake's model of diverging

waves from a point source were programmed for computer analysis. Variations of the displacement resulting from changes in the pressure function, propagational velocity, range, and cavity size were investigated. Results of the research are given. In general, Fourier amplitudes at frequencies below the natural frequency of the cavity scale to the first power of charge size, and Fourier amplitudes at frequencies above the natural frequency of the cavity scale to a fractional power of charge size.

1946

Oregon State U., Corvallis.

THEORETICAL AND FIELD STUDIES OF SEISMIC WAVES, by J. W. Berg, Jr. Final research rept. Apr. 1, 1962-Apr. 1, 1964, 6p. (AF AFOSR-62-376) AD 612033   Unclassified

The objective of the research was to determine a method for evaluating the size of a seismic source using amplitudes and/or energy content of the seismic waves generated by the source. Each distance range (local, near-regional, regional, and telescismic) was considered separately to divide the major problem into several smaller ones. Only the initial seismic disturbance was considered for this work. Data recorded from Gnome, Hardhat, Haymaker, and Shoal nuclear explosions were chosen to represent the seismic sources for this work. The research that was done for seismic waves recorded in the various distance ranges will be discussed. In general, the continuity of energy of the seismic waves recorded from the above explosions was sought for the entire range of distances over which the seismic waves were recorded.

1947

Oregon State U. [Dept. of Chemistry] Corvallis.

INVESTIGATIONS OF THE STRUCTURES AND DYNAMICS OF MOLECULES BY ELECTRON DIFFRACTION, by K. Hedberg and L. Hedberg. Final rept. 1963, 10p. (AFOSR-4659) (AF 49(638)783) AD 410007   Unclassified

The contents of this report are: Geometry: dinitrogen pentoxide, fluorine fluorosulfonate, cyclopropane, butadiene-1,3, disiloxane, hexachlorobenzene, and hexabromobenzene; Amplitudes of vibration: phosphorus trichloride; Methods of structure determination: least squares; Work in progress: cyclooctadiene-1,5, disilyl sulfide, nitrogen dioxide, and arsenic tribromide.

1948

Oregon State U. [Dept. of Chemistry] Corvallis.

THE MOLECULAR STRUCTURE OF DISILOXANE, $(SiH_3)_2O$, by A. Almenningen, O. Bastiansen and others. [1963] [6]p. (AFOSR-64-0932) (AF 49(638)-783) AD 439074   Unclassified

Also published in Acta Chem. Scand., v. 17: 2455-2460, 1963.

The structure of gaseous disiloxane (disilyl ether) has been studied by electron diffraction. The Si-O-Si angle is extraordinarily large, in agreement with conclusions from infrared and Raman spectroscopy, and with results of an earlier electron-diffraction investigation. The structural results are derived from a least squares analysis based on intensity curves. The standard errors contain estimates of systematic errors. The large Si-O-Si bond angle and the short Si-O bond distance are most likely due to conjugation of unshared electron pairs on the oxygen atom with d orbitals from the silicon atom.

1949

Oregon State U. Dept. of Chemistry, Corvallis.

LEAST-SQUARES REFINEMENT OF MOLECULAR STRUCTURES FROM GASEOUS ELECTRON-DIFFRACTION SECTOR-MICROPHOTOMETER INTENSITY DATA. I. METHOD, by K. Hedberg and M. Iwasaki. [1964] [5]p. (AFOSR-67-0275) (AF 49(638)783) Unclassified

Also published in Acta Cryst., v. 17: 529-533, May 1964.

An adaptation of the method of least squares to the refinement of molecular structures, based on gaseous electron-diffraction sector-microphotometer intensity data, is presented. The method has the advantages of permitting simultaneous refinement of many more parameters than can be handled by trial-and-error methods and of opening the possibility of obtaining realistic standard errors and error correlations in place of the more subjective 'error limits.' Although the problem of weighting of the observations is not solved, it is felt that the method provides a more straightforward way to take account of factors known to introduce uncertainties than does the alternative approach based on radial distribution functions. A brief account of general experience with the method is given. (Contractor's abstract)

1950

Oregon State U. Dept. of Chemistry, Corvallis.

LEAST-SQUARES REFINEMENT OF MOLECULAR STRUCTURES FROM GASEOUS ELECTRON-DIFFRACTION SECTOR-MICROPHOTOMETER INTENSITY DATA. II. ADAPTATION TO AUTOMATIC COMPUTATION, by M. Iwasaki, F. N. Fritsch, and K. Hedberg. [1964] [5]p. incl. diagrs. (AFOSR-67-0276) (AF 49-(638)783)   Unclassified

Also published in Acta Cryst., v. 17: 533-537, May 1964.

A description is given of a computer program representing an adaptation of a least-squares method of molecular structure refinement based on gaseous electron-diffraction sector-microphotometer data. (Contractor's abstract)

1951

Oregon State U. Dept. of Chemistry, Corvallis.

LEAST SQUARES REFINEMENT OF MOLECULAR STRUCTURES FROM GASEOUS ELECTRON-DIFFRACTION SECTOR MICROPHOTOMETER DATA. III. REFINEMENT OF CYCLOPROPANE, by G. Bastiansen, F. N. Fritsch, and K. Iberg. [1964] [6]p. incl. diagrs. refs. (AFOSR-67-0277) (AF 49(638)783)
Unclassified

Also published in Acta Cryst., v. 17: 538-543, May 1964.

The method of least squares was applied to the cyclopropane structure, using data from the Norwegian diffraction apparatus (Skancke, 1960). The general refinement (including $H \cdots H$ interactions) led to results for six distances and root-mean-square amplitudes of vibration, all in Å, and two interesting angles. The standard errors include estimates of all known systematic effects deriving from the experiments and method of data reduction, and estimates of correlation among the intensity data. However, tests of various refinement conditions have revealed certain systematic changes in the values of the mean amplitudes of unknown cause, which suggest caution. No such effects on the distances were observed, and we feel they may be accepted with confidence. (Contractor's abstract, modified)

1952

Oregon State U. Dept. of Chemistry, Corvallis.

THE MECHANISM OF THE DISPROPORTIONATION OF SULFINIC ACIDS. THE THERMAL DECOMPOSITION OF p-TOLUENESULFINYL p-TOLYL SULFONE AND ITS REACTION WITH p-TOLUENESULFINIC ACID, by J. L. Kice and N. E. Pawlowski. [1963] [2]p. incl. table. (AFOSR-J657) (AF AFOSR-63-106) AD 415467
Unclassified

Also published in Jour. Org. Chem., v. 28: 1162-1163, Apr. 1963.

Evidence was presented to show that there was no direct reaction between p-toluenesulfinyl p-tolyl sulfone (I) and p-toluenesulfinic acid (II) in anhydrous dioxane. Rather, consumption of II occurred as a result of its reaction with intermediates formed by a rate determining unimolecular decomposition of I. Kinetic studies revealed that I decomposed rapidly in dioxane at 50°. This decomposition followed first-order kinetics and had a half life of 25 min. The rate constant was the same as in the absence of II. Although without kinetic influence, added II was consumed during the decomposition of I, and its presence altered the product composition from that obtained in its absence. Decomposition of a 0.05M solution (2.50 mmol) of I in the absence of II gave 1.2 mmol p-tolyl p-toluenethiolsulfonate, 0.20 mmol p-tolyl disulfide, and 1.86 mmol p-toluenesulfonic acid. One plausible structure for the intermediate was the sulfenyl sulfonate ($ArSO_2OSAr$)

(II). By analogy with the chemistry of sulfenyl halides, III should react rapidly with the sulfinic acid to give the observed products.

1953

Oregon State U. [Dept. of Chemistry] Corvallis.

MECHANISMS OF REACTIONS OF SULFINIC ACIDS. VI. THE MECHANISM OF THE DISULFIDE-SULFINIC ACID REACTION, by J. L. Kice and E. H. Morkved. [1964] [9]p. (AFOSR-64-1508) (AF AFOSR-63-106) AD 446141
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2270-2278, June 5, 1964.

A significant extension of our understanding of the disulfide-sulfinic acid reaction have now been achieved through study of the reaction of a wide variety of disulfides with p-toluenesulfinic acid. For all alkyl disulfides the principal reaction product is the alkyl p-toluenethiolsulfonate, accompanied by small amounts of p-tolyl p-toluenethiolsulfonate and alkyl p-tolyl disulfide. Because of the relative availability of the starting materials and the predominant formation of the alkyl p-toluenethiolsulfonate, the reaction offers a potentially practical route for the synthesis of unsymmetrical thiolsulfonates. The kinetics of the reaction vary with disulfide structure, being second order in disulfide for nucleophilic primary alkyl disulfides, such as methyl or n-butyl, and first plus second order for both less nucleophilic primary ones, such as benzyl and sec-alkyl disulfides, such as isopropyl.

1954

Oregon State U. [Dept. of Chemistry] Corvallis.

THE REACTION OF SEC-ALKYL SULFIDES WITH P-TOLUENESULFINIC ACID, by J. L. Kice and E. H. Morkved. [1964] [3]p. (AFOSR-64-1816) (AF AFOSR-63-106) AD 449066
Unclassified

Also published in Jour. Org. Chem., v. 29: 1942-1944, July 1964.

The reaction of several sec-alkyl sulfides with p-toluenesulfinic acid has been investigated. As with their primary counterparts, the principal reaction involves cleavage of the sulfide, the products being p-tolyl p-toluenethiolsulfonate, the sec-alkyl p-toluenethiolsulfonate, and the ketone derived from oxidation of the sec-alkyl group. However, with 2-octyl sulfide the reaction appears to be somewhat more complex than usual, since some of the sulfide is also oxidized to the sulfoxide. The reactivity of sec-alkyl sulfides is distinctly lower than expected from the reactivity of primary alkyl sulfides. Evidence is presented that this is due to the influence of steric hindrance on the initial equilibrium involving sulfinic acid and sulfide.

1955

Oregon State U. Dept. of Chemistry, Corvallis.

CONCOMITANT ELECTROPHILIC AND NUCLEOPHILIC
CATALYSIS OF SULFUR-SULFUR BOND CLEAVAGE
IN ARYL THIOLSULFINATES, by J. L. Kice and C.
G. Venier. [1964] [6]p. incl. tables. (AFOSR-65-0009)
(AF AFOSR-63-106) AD 455705   Unclassified

Also published in Tetrahedron Ltrs., No. 48: 3629-
3634, 1964.

It was found that in acetic acid containing small amounts
of water and sulfuric acid phenyl benzenethiolsulfinate
reacts much more readily with aromatic sulfinic acids
(ArSO$_2$H) than it undergoes disproportionation. Kinetic
study of the reaction under conditions where the sulfinic
acid is in considerable stoichiometric excess shows that
the reaction is first order in both sulfinic acid and
thiolsulfinate, subject to what appears to be general
acid catalysis by added sulfuric acid, and little affected
by a change in the stoichiometric concentration of water.

1956

Oregon State U. Dept. of Chemistry, Corvallis.

THE DECOMPOSITION OF AROMATIC SULFINYL
SULFONES (SULFINIC ANHYDRIDES). THE FACILE
HOMOLYSIS OF A SULFUR-SULFUR BOND, by J. L.
Kice and N. E. Pawlowski. [1964] [7]p. incl. diagrs.
tables, refs. (AFOSR-65-0010) (AF AFOSR-63-106)
AD 455929   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86:
4898-4904, Nov. 20, 1964.

Aromatic sulfinyl sulfones undergo rapid decomposition
at 50°C, the rate being little affected by either solvent
or the nature of the aryl group. Experiments using
galvinoxyl, and the trapping of ArSO$_2$ radicals by an
added olefin, show that the decomposition involves the
facile homolysis of the sulfur-sulfur bond to give ArSO$_2$
and ArSO. In the absence of a radical trap these radi-
cals then recombine, yielding the sulfenyl sulfonate.

1957

Oregon U. Dept. of Chemistry, Eugene.

RESEARCH ON MOLECULAR COMPLEXATION AND
REACTIONS OF NON-POLAR MOLECULES AT PO-
LARIZING SURFACES. PART I, by L. H. Klemm.
Final rept. Sept. 1, 1956-Aug. 31, 1962. Jan. 10,
1963, 27p. incl. diagrs. tables. (AFOSR-4496, Pt. 1)
(AF 49(636)473) AD 610813   Unclassified

Studies were undertaken to ascertain (1) the stereorela-
tionships involved in surface-substrate interactions of
non-polar organic molecules on polarizing inorganic
surfaces and (2) the effect of such surface-substrate
interaction on chemical reaction between the adsorbed
substrate and a third substance (either adsorbed or in
solution). The following methods of approach were in-

vestigated: adsorption chromatography on alumina;
molecular complexation chromatography; polarographic
reduction at the mercury cathode; catalytic hydrogena-
tion using platinum; molecular complexation in Diels-
Adler condensation. It was possible to correlate the
physiochemical processes which occur when non-polar
molecules undergo reaction at polarizing surfaces and
to observe the relative degrees of importance of reso-
nance, polar, and steric factors in the processes in-
vestigated.

1958

Oregon U. Dept. of Chemistry, Eugene.

RESEARCH ON MOLECULAR COMPLEXATION AND
REACTIONS OF NON-POLAR MOLECULES AT POLAR-
IZING SURFACES. PART II. THE CATALYTIC HYDRO-
GENATION OF ALKENYLNAPHTHALENES, by R. H.
Mann. (Doctoral thesis) Final rept. Sept. 1, 1958-
Aug. 31, 1962. Jan. 10, 1963, 85p. incl. illus. diagrs.
tables, refs. (AFOSR-4496, Pt. 2) (AF 49(638)473)
AD 610814   Unclassified

The rates of catalytic hydrogenation of 14 alkenylnaph-
thalenes and related compounds in acetic and propionic
acid were determined. Activation energies were deter-
mined but no significant differences were found from
compound to compound. The values of the rate constant
for the reduction of the alkenic double bond were found
to depend on chemical structure. The rate of hydrogena-
tion decreased with the amount of substitution of the
alkenic double bond. For trisubstituted alkenes, satis-
factory conformation was found with the theory that the
rate of hydrogenation should decrease as the steric
hindrance to attainment of coplanarity increases. For
disubstituted and monosubstituted alkenes the α-substi-
tuted naphthalenes reacted more rapidly than the β-
substituted naphthalenes in agreement with the higher
free valence on the α-carbon than on the β-carbon of
naphthalene itself. (Contractor's abstract)

1959

Oregon U. Dept. of Chemistry, Eugene.

RESEARCH ON MOLECULAR COMPLEXATION AND
REACTIONS OF NON-POLAR MOLECULES AT POLAR-
IZING SURFACES. PART III. MOLECULAR COMPLEX-
ATION AND DIENE CONFORMATION IN THE DIELS-
ALDER REACTION, by W. C. Solomon. Final rept.
Sept. 1, 1958-Aug. 31, 1962. Jan. 10, 1963, 167p.
incl. diagrs. tables, refs. (AFOSR-4496, Pt. 3)
(AF 49(638)473) AD 610815   Unclassified

Systems using vinylnaphthalenes with tetracyanoethyl-
ene were employed in an attempt to decide the role of
molecular complexation in Diels-Alder reactions, and
in a study of the effect of changing diene conformation
upon the rate of Diels-Alder addition.

1960

Oregon U. Dept. of Chemistry, Eugene.

POLAROGRAPHIC REDUCTION OF SOME ALKYL-, ALKYLENE-, AND POLYMETHYLNAPHTHALENES, by L. H. Klemm and A. J. Kohlik. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-J1151) (AF 49(638)473) AD 423131   Unclassified

Also published in Jour. Org. Chem., v. 28: 2044-2049, Aug. 1963.

Polarography was conducted on naphthalene and twenty-seven substituted naphthalenes. Using naphthalene as a standard of comparison the change in the half-wave reduction potential, $-\Delta E_{1/2}$, for the single wave obtained for each of the derivatives is postive, consistent with a decrease in ease of electroreduction due to the substituent(s). For the monoalkyl derivatives plots of $-\Delta E_{1/2}$ vs σ^*, the polar substituent constant, for the 1- and for the 2-series are linear. There is no indication of a steric effect due to the bulkiness of the alkyl group. For dimethylnaphthalenes approximate addivity in $-\Delta E_{1/2}$ exists, except for the cases of the 1,8- and 2,3-isomers, where an enhancement potential must be included in order to retain additivity. (Contractor's abstract)

1961

Oregon U. Dept. of Chemistry, Eugene.

CATALYTIC HYDROGENATION OF SOME NAPHTHYL ALKENES, by L. H. Klemm and R. Mann. [1964] [5]p. incl. diagrs. table, refs. (AFOSR-64-1413) (AF 49-(638)473) AD 444445   Unclassified

Also published in Jour. Org. Chem., v. 29: 900-904, Apr. 1964.

Rates of catalytic hydrogenation of twelve naphthyl alkenes and two cycloakyl naphthalenes have been studied using acetic and propionic acids as solvents, Adams' platinum as catalyst, both constant volume and constant temperature (5°-40°C), and 1-2-atm pressure. For most of the naphthyl alkenes, first-order rate plots (with respect to the pressure of hydrogen) showed two linear portions corresponding to (1) more rapid reduction of the alkenyl double bond (accompanied by some reduction of the naphthalene ring) and to (2) slower reduction of the resultant alkyl naphthalene, respectively. In general, rate constants of hydrogenation increased with increasing temperature, increase from acetic acid to propionic acid, and (for process 1) with decrease in number of substituents on the carbon atoms of the alkenyl double bond. There was no evidence of preliminary double bond migration. (Contractor's abstract)

1962

Oregon U. Dept. of Chemistry, Eugene.

OPTICAL RESOLUTION OF 9-SEC-BUTYLPHEN-ANTHRENE BY MOLECULAR COMPLEXATION

CHROMATOGRAPHY, by L. H. Klemm, K. B. Desai, and J. R. Spooner, Jr. [1964] [3]p. (AFOSR-64-1414) (AF 49(638)473) AD 444444   Unclassified

Also published in Jour. Chromatog., v. 14: 300-302, 1964.

Klemm and Reed described the use of columns of silictc acid impregnated with the optically active molecular complexing agent (+)- or (-)-α-(2,4,5,7-tetranitro-9-fluorenylidenea-minooxy)-propionic acid for optical resolution of an ether and of an ester containing one center of asymmetry (on carbon) for each compound. In addition the method was used for optical resolution of a hydrocarbon wherein optical activity results from serious restriction to rotation around a pivotal bond of the biphenyl type. The successful extension of the method to the partial optical resolution of 9-sec-butyl-phenanthrene, a hydrocarbon containing a single center of asymmetry and expected to have a small specific rotation is reported. (Contractor's abstract)

1963

Oregon U. Dept. of Chemistry, Eugene.

GAS-SOLID ADSORPTION CHROMATOGRAPHY OF SOME AROMATIC HYDROCARBONS AND NITROGEN HETEROCYCLES ON ALUMINA, by L. H. Klemm and S. K. Airee. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-1415) (AF 49(638)473) AD 444451   Unclassified

Also published in Jour. Chromatog., v. 13: 40-47, 1964.

By means of gas-solid adsorption elution chromatography on alumina, either plain or pre-treated with non-eluting quinuclidine, retention times and heats of adsorption were determined for benzene, eight monalkylbenzenes, m-xylene, naphthalene, and 2,6-lutidine. In general both retention time and heat of adsorption decreased on impregnating the alumina with quinuclidine. (Contractor's abstract, modified)

1964

Oregon U. Dept. of Mathematics, Eugene.

BASIC RESEARCH IN PROBABILITY AND STATISTICS OF SEVERAL SAMPLE PROBLEMS. Final rept. July 1, 1961-June 30, 1963. July 31, 1963, 53p. incl. tables, refs. (AFOSR-5230) (AF 49(638)1057) AD 415959   Unclassified

This paper develops for the several sample problem the notions of a parametric family of non-parametric alternatives. In section two it gives a detailed characterization of the class of all locally most powerful rank order tests for testing the hypothesis of equality of several continuous distributions. In section three it is shown that the class of all locally most powerful rank order tests coincides with the class of all locally least powerful tests. Section four considers a multiple decision problem with non-parametric slippage alternatives and characterize the class of all locally best symmetric decision procedures based on rank orders.

1965

Oregon U. [Dept. of Mathematics] Eugene.

FOURIER SERIES IN SEVERAL VARIABLES, by V. L. Shapiro. [1964] [46]p. (AFOSR-64-0572) (AF AFOSR-63-351) AD 434319   Unclassified

Also published in Bull. Amer. Math. Soc., v. 70: 48-93, Jan. 1964.

This article is a survey of certain aspects of the theory of multiple Fourier and trignometric series. The main theorems are proved in a discussion of two bibliographies, a bibliography for the survey itself, and a general bibliography in which is described the classical theory of the Bochner-Riesz summability of multiple Fourier series and the Abel summability of multiple Fourier series. Bochner's counter-example for the critical index in summability theory in considerable detail is presented. Also the uniqueness of multiple trigonometric series is presented which proves the main theorem in the subject so far, i.e., uniqueness under Abel summability. Some results in conjugate multiple Fourier series are described, defined by means of the Calderon-Zygmund kernel and related topics, i.e., analyticity in several varialbes, and the Riemannian theory of multiple trigonometric series, some applications to geometric integration theory and potential theory.

1966

Oregon U. [Dept. of Physics] Eugene.

OPTICAL ABSORPTION IN CaO SINGLE CRYSTALS, by V. I. Neeley and J. C. Kemp. [1963] [4]p. (AFOSR-64-0417) (AF AFOSR-62-180) AD 435664   Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 1301-1304, 1963.

The optical absorption of CaO single crystals has been measured in the range 14.5μ-200 mμ. Absorption bands begin at approximately 250 mμ on the high energy side of the visible region and at 10μ on the low energy side. $Ca(OH)_2$, which readily forms on the surface of these crystals when left standing shows the strong (OH) stretching absorption at $2.755\ \mu$. Surface effects also cause a weaker band at 260 mμ. Special precautions were necessary to eliminate these spurious absorptions.

1967

Oslo U. Inst. for Theoretical Physics (Norway).

ON THE CONCEPTION OF GENERALIZED SPIN OF FREE DIRAC PARTICLES, by E. A. Hylleraas. [1964] [9]p. (Inst. rept. no. 22) (AFOSR-65-0453) (AF 61(052)134) AD 614219   Unclassified

Using the spinor matrix method, several concepts of free Dirac particles are developed. First shown is the similarity in spin eigenvalue equations as expressed by Pauli matrices and spinor matrices. An energy eigen-value equation is given, and then some combined energy-spin solutions are derived. Other forms of modified and generalized spin are considered in the field of Lorentz transformations such as Rose spin and the Foldy-Wouthuysen transformation. Also discussed is the question of spin-energy quantized eigenfunction and the mean value of spin.

1968

Oslo U. Inst. for Theoretical Physics (Norway).

THE GENERAL ORTHOGONALITY THEOREM IN THE HYLLERAAS-SCHERR-KNIGHT VARIATIONAL PERTURBATION METHOD, by J. Midtdal. 1964 [8]p. (Inst. rept. no. 25) (AFOSR-65-0454) (AF 61(052)134) AD 614220   Unclassified

The present report is concerned with the problem of whether some corresponding orthogonality relations may be stated when using the Hylleraas-Scherr-Knight variational perturbation method. The theorem is developed by summarizing this method and by reviewing work done previously for orthogonality relations. Sufficient orthogonality requirements for excited states are given, and from this the following general orthogonality theorem is developed: The approximate perturbation wave functions furnished by the variational equations of the Hylleraas-Scherr-Knight procedure will automatically, to any order, satisfy the same orthogonality conditions as the exact perturbation wave functions.

1969

Oslo U. Inst. for Theoretical Physics (Norway).

[ON FORMULATION OF SPINORS. II. THE QUESTION OF GENERALIZED SPIN] Über die Darstellung von Spinoren. II. Zur Frage des generalisierten Spins, by E. A. Hylleraas. [1964] [6]p. (Inst. rept. no. 24) (AFOSR-65-0717) (AF 61(052)134) AD 615067   Unclassified

Also published in Zeitschr. Phys., v. 182: 58-63, 1964.

The method of spinor matrices leads to a simple definition of a generalized spin, i.e., of like spin operator, which one may quantize for a free-moving Dirac particle in any arbitrary direction. This spin is compared with other forms of generalized spins.

1970

Oslo U. Inst. for Theoretical Physics (Norway).

SOME THEORETICAL INVESTIGATIONS FOR CLOSED STATES OF THE NEGATIVE HYDROGEN ION. PART I, by J. Midtdal. 1964 [33]p. incl. diagrs. tables, refs. (Inst. rept. no. 21) (AFOSR-64-1256) (AF EOAR-64-32) AD 605259   Unclassified

This report contains previous investigations, coordinate systems and sets of wave functions; the singlet and triplet S-states of two s-electrons; the $1s2p\ ^3P$ state

of a two-electron system; the states $(2p)^2 {}^3P$ and $2p3p$
${}^3P$; perturbation theory expansion of the non-relativistic
energy of the state $(2p)^2 {}^3P$.

1971

Oslo U. Neurophysiological Lab. (Norway).

EXCITATORY AND INHIBITORY BLADDER RE-
SPONSES TO STIMULATION OF THE CEREBRAL
CORTEX IN THE CAT, by R. Gjone and J. Setekleiv.
[1963] [12]p. incl. diagrs. refs. (AFOSR-65-1290)
(AF EOAR-62-36) AD 620945   Unclassified

Also published in Acta Physiol. Scand., v. 59: 337-
348, 1963.

A continuous intravesical pressure recording was
established in 22 anesthetized cats by operative canaliza-
tion of the bladder cavity, leaving the urinary outlet
intact. The intravesical pressure variations caused by
controlled volume changes were studied, and the altera-
tions in bladder activity in response to stimulation of
the cerebral cortex were recorded. The following ex-
citatory bladder reactions on cortical stimulation are
described: (1) augmentation of the rhythmic contrac-
tions; (2) dropwise expulsion of the bladder contents
with incomplete emptying of the vesical cavity; and
(3) a normal micturition act with forceful detrusor con-
tractions. With regard to inhibitory effects the following
responses were obtained: reduction or complete inhibi-
tion of the rhythmic bladder activity, arrest of the
urination act or suppressed micturition. In agreement
with previous investigations excitatory bladder re-
sponses were obtained from the first sensory-motor
area and from the anterior cingulate region. In addi-
tion, excitatory effects were elicited by stimulation of
the anterior ectosylvian and anterior sylvian gyri.
(Contractor's abstract, modified)

1972

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED
RABBIT. I. ISOTONIC AND ISOMETRIC RECORDING
IN VIVO. INFLUENCE OF ANESTHESIA AND TEM-
PERATURE, by J. Setekleiv. [1964] [11]p. incl.
diagrs. refs. (AFOSR-65-1574) (AF EOAR-62-36)
AD 623346   Unclassified

Also published in Acta Physiol. Scand., v. 62: 68-78,
1964.

A technique for isotonic and isometric recording of
uterine contractions in vivo is described. No significant
difference was found in the spontaneous contractions
recorded simultaneously from the 2 horns by the 2
methods. Differences were found, however, in the
responses to gradually increasing stimuli, such as
increasing concentrations of noradrenaline or of in-
creasing strength of stimulation of the hypogastric
nerve. The isotonic response rapidly reached a maxi-
mum, whereas the isometric response increased more
gradually. Since the isotonic response can be maximal
in spite of submaximal activation, the isometric re-

sponse is a more reliable quantitative measure, which
is in agreement with previous findings with in vitro re-
cording. However, the qualitative evaluation of re-
sponses near threshold stimulation, isotonic recording
at low loads is preferable. (Contractor's abstract,
modified)

1973

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED
RABBIT. II. RESPONSE TO DISTENSION, by J.
Setekleiv. [1964] [15]p. incl. diagrs. refs. (AFOSR-
65-15'5) (AF EOAR-62-36) AD 623347
                                        Unclassified

Also published in Acta Physiol. Scand., v. 62: 79-93,
1964.

The myometrial response to rapid distension consists
of a quick contraction, the early stretch response,
followed by an increase in the rhythmic activity. The
latency and amplitude of the early contraction has been
studied during increasing degrees of distension and dur-
ing repetitive distensions. The frequency of the rhythmic
contractions increases with increasing distension; the
amplitude and the external work performed by each
contraction at first increases and later decreases. Data
obtained from isometric and isotonic recordings indicate
that the pacemaker activity is not directly related either
to the intra-uterine volume or to the intra-uterine pres-
sure but rather to the tension in the myometrial cells.
The independency with which the 2 horns respond to
distension, the lack of effect of local and spinal anesthe-
sia and of autonomic blocking agents indicates that the
active response to distension is of myogenic origin.
The intra-uterine pressure is not maintained during
constant distension but decreases at first rapidly, later
more slowly. (Contractor's abstract)

1974

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED
RABBIT. III. RESPONSE TO HYPOGASTRIC AND
SPLANCHNIC NERVE STIMULATION, by J. Setekleiv.
[1964] [13]p. incl. diagrs. refs. (AFOSR-65-1576)
(AF EOAR-62-36) AD 623348   Unclassified

Also published in Acta Physiol. Scand., v. 62: 137-
149, 1964.

The amplitude of the uterine contraction elicited by a
few sec stimulation of the hypogastric nerve depends
on: (1) the stimulus frequency, the contraction being
maximal at 30 to 50 cps; (2) the excitability of the myo-
metrium, being increased in a period from 20 to 60 sec
following a preceding stimulus, and (3) the degree of
uterine distension. Whereas stimulation for a few sec
elicits a single contraction, prolonged stimulation (for
several min) at low frequencies (5-10 cps) evokes a
series of rhythmic contractions. Prolonged stimulation
at frequencies above 10 cps causes in addition a transi-
ent elevation of the minimum pressure. The iv

administration of cocaine does not potentiate the response to hypogastric nerve stimulation, whereas potentiation by cocaine is obtained when the agent is applied intra-uterinely. This effect, as well as the response to adrenergic blocking agents, indicates the presence of adrenergic fibers in the hypogastric nerve supplying the myometrium. (Contractor's abstract, modified)

1975

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED RABBIT. IV. REFLEX EXCITATION AND INHIBITION, by J. Setekleiv. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-1577) (AF EOAR-62-36) AD 623349
Unclassified

Also published in Acta Physiol. Scand., v. 62: 304-312, 1964.

The uterus can be reflexly activated by stimulation of the rectum, various somatic nerves, and the central and peripheral ends of the cut vagus nerve. The initial uterine contraction is followed by a period of reduced rhythmic activity. Similar responses can be elicited by asphyxia and by clamping of the common carotid arteries. All these responses are due to activation of the sympathico-adrenal system. A transient inhibition of the spontaneous rhythmic activity is obtained by electrical stimulation of the depressor ner .. Since it is abolished by sympathetic blocking agents, it is most likely due to a reduction of a sympathetic tonic influence. The results indicate that although the autonomy of the myogenic rhythmic uterine activity is strong in the estrogenized rabbit, it can be influenced by various reflexes. It is suggested that the sympathetic nervous system exerts a tonic influence on the uterus in vivo. (Contractor's abstract)

1976

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED RABBIT. V. RESPONSE TO BRAIN STIMULATION, by J. Setekleiv. [1964] [10]p. incl. diagrs. refs. (AFOSR-65-1578) (AF EOAR-62-36) AD 623350
Unclassified

Also published in Acta Physiol. Scand., v. 62: 313 322, 1964.

Uterine contractions were elicited by electrical stimulation of points located in the lateral part of the medulla oblongata, whereas inhibitory responses were induced from the midline medullary region. Cerebellar stimulation determined an inhibition of the rhythmic uterine activity followed by a rebound effect, on cessation of the stimulation. From the hypothalamus 3 different responses were obtained: (1) excitatory effects from the perifornical, the dorsal, lateral and posterior hypothalamic areas due to sympathetic activation, (2) uterine excitation by oxytocin liberation induced from the ventromedial part of the hypothalamus, and (3) inhibition of

the uterine rhythmic activity by stimulation of a restricted region in the lateral hypothalamic area. Excitatory responses were also evoked from the amygdala, from sensorimotor cortex, and the anterior limbic region. Inhibitory uterine responses were produced from the 2 cortical areas just mentioned as well as from the orbital surface. (Contractor's abstract)

1977

Oxford U. Dept. of Anatomy (Gt. Brit.).

INHIBITION OF OVULATION IN THE GONADOTROPHIN-TREATED IMMATURE RAT BY CHLORPROMAZINE, by M. X. Zarrow and K. Brown-Grant. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-1546) (AF EOAR-62-111) AD 624013   Unclassified

Also published in Jour. Endrocrinol., v. 30: 87-95, 1964.

The effect of age and dose of a single injection of pregnant mare serum gonadotrophin on spontaneous ovulation in immature Wistar rats is described. Ovulation could be induced by human chorionic gonadotrophin at least 6 days before it occurred when pregnant mare serum gonadotrophin alone was given. Chlorpromazine was shown to block pregnant mare serum gonadotrophin-induced ovulation at a dose level (0.25 mg in a 60 g rat) which has no effect on the ovulatory response to human chorionic gonadotrophin. Higher doses interfered with the action of injected human chorionic gonadotrophin. Ovulation could be induced in the chlorpromazine-blocked animals by the systemic injection of an extract of bovine median eminence, but the sensitivity was too low to use this response for an assay method. (Contractor's abstract)

1978

Oxford U. [Dept. of Anatomy] (Gt. Brit.).

EFFECTS OF ENDOCRINES OF DEVELOPMENT AND BEHAVIOR, by G. W. Harris. Final rept. Apr. 1, 1964-Sept. 30, 1964, 8p. (AFOSR-65-0667) (AF EOAR-64-3) AD 614590   Unclassified

The investigatio has consisted of four projects concerning the release of lutcinizing hormone in the rabbit, the releasing factor content of portal vessel blood, ovulation in immature rats, and concentration and activity of thyrotrophic hormone in blood.

1979

Oxford U. [Dept. of Anatomy] (Gt. Brit.).

SEX HORMONES, BRAIN DEVELOPMENT AND BRAIN FUNCTION, by G. W. Harris. [1964] [22]p. incl. illus. diagrs. refs. (AFOSR-65-1295) (AF EOAR-64-3) AD 621460   Unclassified

Presented at Annual meeting of the Endocrine Soc., San Francisco, Calif., June 19, 1964.

Also published in Endocrinology, v. 75: 627-648, Oct. 1964.

The view that gonadal hormones exert a double action on the central nervous system, t. e., inductive during development and excitatory in the adult allows a direct comparison between the brain and genital tract as target organs for these hormones. In both cases it is generally the male hormone which is dominant in the inductive action in amphibians and mammals. The presence to testis hormone induces, in both genetic males and females, the development of a male genital tract and male type brain. The absence of testis hormone, in the normal female or after gonadectomy in both sexes, allows the development of a female genital tract and a female type brain. Since the inductive influence of the male hormone in the rat appears to be exerted on the genital tract at an earlier stage of development than on the brain, it is possible by experimental procedures (castration of the male at birth, or administration of testosterone to the neonatal female) to obtain a normally organized genital tract in the presence of deviated development of the brain.

1980

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

THE INFLUENCE OF POTASSIUM, SODIUM AND CHLORIDE ON THE MEMBRANE POTENTIAL OF THE SMOOTH MUSCLE OF TAENIA COLI, by H. Kuriyama. [1963] [14]p. (AFOSR-64-1070) (AF EOAR-62-5) AD 441488   Unclassified

Also published in Jour. Physiol. (London). v. 166: 15-28, 1963.

Transmembrane potential and tension of the smooth muscle of isolated taenia coli of the guinea-pig were recorded in solutions of normal and abnormal ionic composition. The relation between the membrane potential and the logarithm of the external K concentration was observed. The experimental results are discussed in relation to the discrepancy between membrane potential of taenia coli and the predicted potassium equilibrium potential. They are consistent with the view that chloride and sodium permeabilities are of greater importance for the determination of the membrane potential of the spontaneously active smooth muscle than they are for the resting skeletal muscle.

1981

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

THE EFFECT OF ADRENALINE ON THE SMOOTH MUSCLE OF GUINEA-PIG TAENIA COLI IN RELATION TO THE DEGREE OF STRETCH, by E. Bulbring and H. Kuriyama. [1963] [15]p. (AFOSR-64-1071) (AF EOAR-62-5) AD 441487   Unclassified

Also published in Jour. Physiol. (London), v. 169: 198-212, 1963.

The effect of stretch on membrane potential, membrane activity and tension was observed in the smooth muscle

of guinea-pig taenia coli. The degree of stretch was defined by the ratio (wet weight/length), the W:L ratio, which corresponds to the cross-sectional area. In the steady state the membrane potential, the amplitude and rate of rise of the spike were maximum at W:L = 0.9. The membrane potential was lower in completely loose, unstretched tissue (W:L > 0.9). It was much lower in stretched muscle (W:L < 0.9), in which the membrane potential decreased in direct proportion to the decrease of the W:L ratio. After sudden stretch the adaptation of tension took 10-20 sec, but the membrane potential reached a steady state only in 5 min. Similarly, after sudden release, membrane activity and tension were completely abolished, and adaptation took up to 5 min.

1982

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

EFFECTS OF CHANGES IN IONIC ENVIRONMENT ON THE ACTION OF ACETYLCHOLINE AND ADRENALINE ON THE SMOOTH MUSCLE CELLS OF GUINEA-PIG TAENIA COLI, by E. Bulbring and H. Kuriyama. [1963] [16]p. (AFOSR-64-1072) (AF EOAR-62-5) AD 441477   Unclassified

Also published in Jour. Physiol. (London), v. 166: 59-74, 1963.

The effects of acetylcholine and adrenaline on membrane potential, electrical activity and tension have been observed in the isolated taenia coli of the guinea-pig. The degree of depolarization caused by acetylcholine depended on the initial membrane potential prevailing at the time of application. During the acceleration of spike discharge the amplitude and the rates of rise and fall of the action potential were decreased. In K^+-free solution the depolarization caused by acetylcholine was abolished. When the membrane was previously depolarized by excessive K^+ acetylcholine still caused depolarization, but it became ineffective when the potential was reduced to 15 mv. At this level acetylcholine sometimes increased the membrane potential. In Na^+-free solution acetylcholine did not accelerate the spike discharge but still depolarized the membrane.

1983

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

EFFECTS OF CHANGES IN THE EXTERNAL SODIUM AND CALCIUM CONCENTRATIONS ON SPONTANEOUS ELECTRICAL ACTIVITY IN SMOOTH MUSCLE OF GUINEA-PIG TAENIA COLI, by E. Bulbring and H. Kuriyama. [1963] [30]p. (AFOSR-64-1073) (AF EOAR-62-5) AD 441476   Unclassified

Also published in Jour. Physiol. (London), v. 166: 29-58, 1963.

The membrane activity and tension in the presence of normal and abnormal ionic concentrations were recorded in the isolated taenia coli of the guinea-pig. In Kreb's solution the mean membrane potential was 55 mv and the mean parameters of the action potential were: spike amplitude 62 mv, half-duration 7.5 msec, maximum

rate of rise and fall 7. 6 and 7. 4 v/sec, respectively. Total absence of Na^+ in the external solution (replacement with Tris+) transiently hyperpolarized the membrane and stopped spontaneous discharge for a few min. In the absence of Na^+ the time during which spontaneous activity continued as well as the spike amplitude were a function of the external calcium concentration. When in the absence of Na^+ and Ca^{2+} all activity had ceased, the addition of calcium restored spontaneous discharge of action potentials for 30 min. In excess Na^+ the absence of Ca^{2+} caused the membrane potential to oscillate.

1984

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

ELECTROPHYSIOLOGICAL OBSERVATIONS ON THE MOTOR INNERVATION OF THE SMOOTH MUSCLE CELLS IN THE GUINEA-PIG VAS DEFERENS, by H. Kuriyama. [1963] [16]p. (AFOSR-64-1074) (AF EOAR-62-5) AD 441473   Unclassified

Also published in Jour. Physiol. (London), v. 169: 213-228, 1963.

Neuromuscular junction potentials, action potentials and tension, evoked by nerve stimulation and field stimulation of the muscle, were recorded from single cells in the hypogastric nerve-vas deferens preparation of the guinea-pig. The junction potentials elicited by short pulses (0.01 msec) with either type of stimulation and recorded from the save muscle cell were qualitatively alike although not always of the same amplitude. Facilitation was seen with both types of stimulation, either independent or mutually influencing each other, the overlap being variable in different cells.

1985

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

BRAIN STEM STIMULATION AND ETHOLOGICAL STUDIES ON BIRDS, by N. Tinbergen, D. M. Vowles, and J. D. Delius. Final technical rept. Dec. 1, 1962-Dec. 31, 1963, 7p. (AFOSR-64-0106) (AF EOAR-62-22) AD 430662   Unclassified

This research was conducted to provide detailed descriptions of the birds' behavior and to analyze in greater detail the motivation of various behavioral systems, in order to provide a descriptive and motivational basis by which the behavior of birds in the wild may be compared with that obtained by stimulation techniques. A number of behavioral systems—territorial behavior, pair-bond formation and maintenance, copulation, nest-building, incubation, grooming the body surface and bathing were examined. Preliminary analysis suggests that care of the body surface is motivated by two, probably independent, systems: preening and 'comfort.' It has been shown that preening is controlled by a combination of postural facilitation and local external stimulation.

1986

Oxford U. Dept. of Biochemistry (Gt. Brit.).

METABOLISM OF C_1 COMPOUNDS BY MICRO-ORGANISMS, by H. Krebs and J. R. Quayle. [Final rept.] 1963 [20]p. incl. tables, refs. (AFOSR-J1179) (AF EOAR-62-45) AD 422920

Growth of Pseudomonas methanicaon methane or methanol as sole carbon source has been studied by following the course of incorporation of C^{14} labelled growth substrate into cell constituents using chromtographic and radioautographic techniques. It has been found that radioactivity from either C^{14} methane or C^{14} methanol appears most rapidly in phosphorylated compounds. This is in contrast with the incorporation of C^{14} methanol or C^{14} formate into Pseudomonas AM1 growing respectively on methanol or formate, where fixation occurs predominantly into serine. The new results with Pseudomonas methanica suggest the possibility of a different pathway. A thiamine pyrophosphate-dependent hydroxymethylation of pentose phosphate has been suggested as one such possibility.

1987

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

CARBON ASSIMILATION BY PSEUDOMONAS OXALATICUS (OX 1). DECARBOXYLATION OF OXALYL-COENZYME A TO FORMYL-COENZYME A, by J. R. Quayle. [1963] [12]p. (AFOSR-64-1189) (AF EOAR-62-45) AD 442996   Unclassified

Also published in Biochem. Jour., v. 89: 492-503, 1963.

Cell-free extracts of oxalate-grown, Pseudomonas oxalaticus catalyze the decarboxylation of oxalyl-CoA and the decarboxylation of oxalate in the presence of catalytic quantities of oxalyl-CoA. An enzyme has been purified from the cell-free extract which catalyzes the decarboxylation of oxalyl-CoA to formyl-CoA. The formyl-CoA has been characterized by chromatography, electrophoresis, formation of hydroxamate, absorption spectrum and hydrolysis to formate. Formyl-CoA is capable of sparking the decarboxylation of oxalate by crude extract of Pseudomonas oxalaticus. The oxalyl-CoA decarboxylase requires thiamine pyrophosphate as cofactor and is stimulated by the presence of Mg^{2+} or Mn^{2+} ions. The decarboxylation is unaffected by the presence of iodoacetate or N-ethylmaleimide. The pH optimum for the decarboxylation is 6.6. No evidence could be found for reversibility of the reaction.

1988

Oxford U. Dept. of Biochemistry (Gt. Brit.).

MICROBIAL GROWTH ON C_1 COMPOUNDS. 6. OXIDATION OF METHANOL, FORMALDEHYDE AND FORMATE BY METHANOL-GROWN PSEUDOMONAS AM1, by P. A. Johnson and J. R. Quayle. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-1580) (AF EOAR-62-45) AD 623380   Unclassified

Also published in Biochem. Jour., v. 93: 281-290, 1964.

A stuoy is presented of the oxidation of C_1 compounds by cell-free extracts of methanol-grown Pseudomonas AM 1. By using 3-amino-1, 2, 4-triazole, a known inhibitor of catalase, the independence of methanol oxidation from catalytic activity was shown. The only enzyme capable of oxidizing methanol was a dehydrogenase that can be linked to phenazine methosulphate and required the presence of NH_4^+ ions. An aldehyde dehydrogenase that reduced 2, 6-dichlorophenolindophenol or phenazine methosulphate in the presence of formaldehyde, and a nicotinamide-adenine nucleotide-linked formate dehydrogenase were found in cell-free extracts and purified by ammonium sulphate precipitation. A comparative study of the oxidation of C_1 compounds by cell-free extracts of Protaminobacter ruber, Pseudomonas extorquens, and Pseudomonas methanica, is also presented.

1989

Oxford U. Dept. of Nuclear Physics (Gt. Brit.).

RESEARCH ON INELASTIC PROCESSES, by J. R. Rook and D. Mitra. Summary technical note. [1963] 10p. (AFOSR-4056) (AF 61(052)455) AD 290701
Unclassified

Work performed for the year 1961-62 is summarized. The topics covered are K mesic atoms, double nuclear stripping, compound nucleus theory and the application of the pairing force model.

1990

Oxford U. Dept. of Nuclear Physics (Gt. Brit.).

RESEARCH ON INELASTIC PROCESSES, by J. R. Rook and D. Mitra. [1964] 16p. incl. refs. (AFOSR-5506) (AF 61(052)455) Unclassified

In this report the information that can be obtained from analysis of K^- mesic atoms and nuclear reactions is investigated. In the case of K^- mesic atoms it is established that nuclear capture takes place in the extreme surface region of the nucleus. It is also established to first order of perturbation theory that there is considerable evidence for nucleon clusters in the nuclear surface. It appears however that second order effects may be sufficiently large to invalidate this conclusion and further experimental evidence is required. In the case of conventional nuclear reactions, (t, p) reactions are mainly analyzed showing that a straightforward application of the zero range distorted wave theory yields angular distributions in disagreement with experiment. It has been shown that finite range or strong coupling effects might resolve this difficulty. The (t, p) reaction is used to obtain information concerning the structure of Li^9 and Ca^{42}. (Contractor's abstract)

1991

Oxford U. Dept. of Pharmacology (Gt. Brit.).

HISTORICAL INTRODUCTION: SPECIFIC INTERACTIONS BETWEEN CATECHOLAMINES AND TISSUES, by H. Blaschko. [1964] [8]p. incl. refs. (AFOSR-65-2961) (AF EOAR-62-80) AD 627851 Unclassified

Also published in Prog. Brain Research, v. 8: 1-8, 1964.

A brief review is given of the development of ideas on specificity. One of the specific sites of importance in the formation of the catechol amines is the enzyme L-dopa decarboxylase. The significance of the phenolic hydroxyl groups, of the alpha-hydrogen atom and of the amino group is discussed. These ideas concern the importance of the meta-hydroxy group and also the fact that the alpha-methyl-amino acids are decarboxylated. It is shown that the new ideas on the structure of pyridoxal enzymes are compatible with earlier pictures of the enzyme-substrate interaction. (Contractor's abstract)

1992

Oxford U. Dept. of Pharmacology (Gt. Brit.).

BENZYLAMINE OXIDASE AND HISTAMINASE: PURIFICATION AND CRYSTALLIZATION OF AN ENZYME FROM PIG PLASMA, by F. Buffoni and H. Blaschko. [1964] [16]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1297) (AF EOAR-64-12) AD 620596 Unclassified

Also published in Proc. Roy. Soc. (London), v. 161B: 153-167, 1964.

The enzyme benzylamine oxidase of pig plasma was purified and some of the properties of the pure preparation were studied. The purification procedure included several precipitations with ammonium sulphate and separations of proteins by column chromatography, first on DEAE-cellulose, followed by DEAE-Sephadex and lastly on a hydroxyapatite column. Crystals were prepared from solutions of the purified enzyme by adding ammonium sulphate. The crystalline preparation was homogeneous when studied by starch-gel electrophoresis and by ultracentrifugation. The molecular weight, as determined on the analytical ultracentrifuge, was 195,000. The copper content of the enzyme, as determined by radioactivation analysis, was about 4 atoms of Cu/molecule of enzyme. Concentrated solutions of the enzyme had a pink color; the color disappeared when substrate (benzylamine) was added under anaerobic conditions. (Contractor's abstract, modified)

1993

Oxford U. [Engineering Lab.] (Gt. Brit.).

RESEARCH ON WAVES IN ANISOTROPIC MEDIA, by H. Motz. Final technical rept. Mar. 15, 1963, 3p. (AFOSR-4754) (AF EOAR-62-62) AD 408481 Unclassified

The radiation impedance of various sources is computed

and it is shown that the average Poynting vector has
the direction of the group velocity. The one dimensional
problem of R-f-confinement was investigated and solved
completely by analytic means. Boltzmann's equation
was solved by means of dyadic Green's functions to
establish a conductivity tensor valid for elevated tem-
peratures. Temperature and collision effects in a plas-
ma were investigated and dispersion surfaces computed.
Photo-emission from a tungsten point was obtained
with light from a ruby laser.

1994

Oxford U. [Engineering Lab.] (Gt. Brit.).

DIAMAGNETIC RESONANT ELECTRONIC EXCITA-
TION OF MICROWAVES, by M. J. Lazarus. [1964]
[10]p. incl. diagrs. refs. (AFOSR-65-0417) (AF
EOAR-63-33) AD 612321   Unclassified

Also published in Brit. Jour. Appl. Phys., v. 15:
1075-1084, 1964.

A theoretical study has been made of the interaction of
two opposing and interpenetrating streams of charged
particles when subjected to a longitudinal magnetostatic
field in a waveguide. The calculations have been made
both classically and quantum mechanically and they show
that, for two frequencies, stimulation is possible. These

are of the order of $\frac{1}{2}$ x cyclotron resonance frequency,
and the system is therefore promising as a generator
or amplifier for very high frequencies. The practical
realization of this device is discussed and a solid state
version using electrons and holes in a semiconductor
is suggested. (Contractor's abstract)

1995

Oxford U. Inorganic Chemistry Lab. (Gt. Brit.).

RECOMBINATION OF CHLORINE ATOMS, by J. W.
Linnett and M. H. Booth. [1963] [2]p. incl. diagr.
(AFOSR-64-0305) (AF EOAR-63-32) AD 434513
                                        Unclassified

Also published in Nature, v. 199: 1181-1182, Sept. 21,
1963.

The rate of recombination of chlorine atoms has been
investigated using a flow system. The atoms were pro-
duced in a microwave discharge, and the atom decay
followed by means of a movable thermocouple probe at
which recombination occurred. The reaction tube of
4-cm internal diameter was poisoned with boric oxide.
Runs using chlorine only, and chlorine/argon mixtures,
were carried out. Linear flow speeds in the range 30-
250 cm/sec, and total pressures of 0.24-3 mm mercury
were used.

1996

Paris U. (France).

CRYSTALLOGRAPHIC STUDY OF DOMAINS IN BARI-
UM TITANATE (Etude cristallographique des domaines
dans le titanate de baryum), by M. Lambert, A. M.
Quittet and others. [1964] [11]p. incl. illus. (AFOSR-
64-2095) (AF 61(052)310) AD 451352   Unclassified

Also published in Jour. Phys., v. 25: 345-355, Mar.
1964.

The unit cell parameters of tetragonal barium titanate
are generally slightly altered. However, some crys-
tals which show a very small tetragonality have been
studied: an optical and crystallographic study reveals
that the ferroelectric domains are then periodically
distributed, the period being proportional to the crys-
tal thickness. This domain configuration seems to be
related to the small tetragonality and can be observed
in ordinary crystals when they are heated to several
degrees below the ferroelectric transition temperature.

1997

Paris U. Lab. de Physique des Solides, Orsay (France).

X-RAY SCATTERING BY POINT-DEFECTS, by A. M.
Levelut and A. Guinier. Final technical rept. [1964]
[28]p. incl. illus. diagrs. (AFOSR-65-0060)
(AF EOAR-62-51) AD 610006   Unclassified

A device is described which was designed to detect the
diffuse x-ray scattering caused by point defects in a
crystal. Tests concerning the sensitivity of the appa-
ratus are summarized, as are results of its applica-
tion to problems involving the degree of order in dif-
fuse solid solutions and the effects of irradiation
crystals.

1998

Paris U. [Lab. de Physique Théorique et Hautes
Energies] Orsay (France).

CRITICAL POINTS OF THE FREQUENCY SURFACES
IN THE SILICON CRYSTAL, by M. Balkanski, W.
Nazarewicz, and E. da Silva. Sept. 15, 1963, 24p.
(Technical note no. 1) (AFOSR-5429) (AF 61(052)572)
AD 611144   Unclassified

The one-phonon and two-phonon infra-red absorption
spectrum (10-130 u) in silicon crystals reveals a struc-
ture due to Van Hove's critical points for frequency
surfaces. From the experimental data it is possible
to obtain the precise values of phonon energies for the
various branches of the frequency spectrum at the fol-
lowing points in the reduced zone γ (0, 0, 0), X (1, 0,
0), L(1/2, 1/2, 1/2), W(1, 1/2, 0) and σ (3/4, 3/4, 0).
These results agree with a set of critical points for the
symmetry properties established on the basis of theoret-
ical, topological and group considerations.

1999

Paris U. [Lab. de Physique Théorique et Hautes
Energies] Orsay (France).

SINGLE PHONON ABSORPTION BANDS IN FAST NEU-
TRON IRRADIATED SILICON, by M. Balkanski and W.
Nazarewicz. Sept. 15, 1963, 18p. (Technical note no.
2) (AFOSR-5430) (AF 61(052)572) AD 611145
Unclassified

Theoretical considerations on the photon phonon inter-
action and experimental results concerning fast neutron
irradiated silicon have been presented. The infrared
absorption spectrum contains absorption bands at 488,
417, 332, and presumably at 140/cm attributed to a
single phonon absorption process connected with the ex-
citation of the fundamental modes, TO, LO, LA, and
TA, respectively. These fundamental modes become
active because of the lattice polarization bombardment.

2000

Paris U. [Lab. de Physique Théorique et Hautes
Energies] Orsay (France).

SPECTROSCOPY OF POINT DEFECTS, by M.
Balkanski, E. da Silva, and W. Nazarewicz. Sept. 15,
1963, 25p. (Technical note no. 3) (AFOSR-5431)
(AF 61(052)572) AD 611194   Unclassified

Also published in Jour. Phys., v. 24: 451-457, July
1963. (AFOSR-64-0768; AD 438242)

The absorption spectra of such impurities as oxygen,
carbon, and nitrogen are being studied in the lattice of
silicon and molecular vibrations are obtained at 9 μ
12.2 μ, and 10.6 μ, respectively. High density defects
created by irradiation with fast neutrons, polarize
the lattice and make it possible to observe the direct
photon-phonon interaction. The infrared absorption
spectra due to single phonons are composed of bands at
488, 417, and 331, as well as at 140/cm, corresponding
to modes TO, LO, LA, and TA, respectively. The en-
ergies of TO, for example, are determined under high
resolution at the point of maximum density of modes at
γ L, W, and X. They are 516.5 ± 1, 488.5 ± 1, 474 ±
1, and 447 ± 1.

2001

Paris U. [Lab. de Physique Théorique et Hautes
Energies] Orsay (France).

LOCALIZED VIBRATIONS DUE TO BORON AND
LITHIUM IN THE SILICON LATTICE, by M. Balkanski
and W. Nazarewicz. Sept. 15, 1963, 15p. (Technical
note no. 4) (AFOSR-5432) (AF 61(052)572) AD 611195
Unclassified

The infrared absorption spectrum of silicon crystals
containing two electrically compensated impurities,
boron and lithium, in concentrations above 10^{19}/cm re-
veals six absorption peaks at: 648, 657, 585, 564, 534
and 522/cm 1 attributed to localized vibrations due to
those impurities.

2002

Paris U. [Lab. de Physique Théorique et Hautes Energies] Orsay (France).

STUDY OF THE OPTICAL PROPERTIES OF HIGHLY DOPED AND DEGENERATE SILICON, by M. Balkanski and J. M. Besson. Oct. 15, 1963, 16p. (Technical note no. 5) (AFOSR-5437) (AF 61(052)572) AD 611146
Unclassified

An investigation was made of the free carrier absorption, the absorption peak at 2.3 μ, and the energy shift of the fundamental absorption edge. The 2.3 μ peak was attributed to intraband transition.

2003

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

THEORETICAL STUDIES OF NUCLEON-NUCLEON INTERACTION AND FORCES, by M. Levy. Feb. 20, 1963, 3p. (AFOSR-J1370) (AF EOAR-62-10)
Unclassified

Most of the work done under this grant has been directed toward following problems: (1) High Energy Interactions of nucleons and anti-nucleons, (2) Application of models to the theory of scattering, (3) Weak interactions, and (4) The Many-body problem.

2004

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

ON THE THEORY OF CLASSICAL FLUIDS. III, by L. Verlet. Mar. 1963, 15p. incl. tables. (Technical note no. 9) (AFOSR-4767) (AF EOAR-63-47)
AD 407167   Unclassified

Also published in Physica, v. 30: 95-104, 1964.

It is shown that Percus' method can be used to write down explicitly integral equations for the two-body correlation function which generalizes the PY and HNC equation. A first test of the fitness of such equations was given in the case of the hard cube gas. Further information will be provided in a future paper where the equations given in the present paper will be applied to the case of the lattice gas.

2005

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

INTERPLAY OF COMPETING RESONANCES, by B. d'Espagnat and F. M. Renard. May 1963, 27p. incl. diagrs. (Technical note no. 10) (AFOSR-5053) (AF EOAR-63-47) AD 415450   Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 536-550, Oct. 16, 1963.

Final state interactions in the $\theta_1 + \theta_2 + N$ system with the possibility of the reactions $\theta_1 + N = V_1$ and $\theta_2 + N = V_2$ are studied. An integral equation and a variational method for approximating it are examined. Interesting "succion" effects of one resonance on the other are obtained. (Contractor's abstract)

2006

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

EIGHTFOLD WAY AND WEAK INTERACTIONS, by M. Gourdin. May 1963, 23p. incl. tables. (Technical note no. 11) (AFOSR-5054) (AF EOAR-63-47) AD 414646
Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 587-602, Oct. 16, 1963.

The octet model is generalized to include the weak interactions. It turns out that the more simple solution is an eight-fold way based on the orthogonal group in an eight-dimensional space SO(8). The mathematical structure of the inclusion between the algebra of the unitary group and the algebra of the orthogonal group is studied. The reduction under unitary transformation of the irreducible representations of the orthogonal group is examined and it can be shown that the orthogonal SO(6) group can generalize the octet model but not the triplet model.

2007

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

THE COLLECTIVE VIBRATIONS OF A MANY-FERMION SYSTEM, by B. Jancovlci and D. H. Schiff. [1964] [9]p. incl. refs. (AFOSR-65-0629) (AF EOAR-63-47) AD 600266   Unclassified

Also published in Nuclear Physics, v. 58: 678-666, 1964.

The energy levels of a many-fermion system are investigated through an extension of the generator coordinate method of Peierls-Yoccoz and Wheeler-Griffin. A trial wave function Ψ for the system is taken as a superposition $\Psi = \int F(z) \, \Phi \, (z) \, dz$ of all possible independent particle wave functions Φ in the neighborhood of the Hartree-Fock ground-state wave function Φ_0; the functions Φ depend on many parameters z. An integral equation is established for the generator function $F(z)$. Through appropriate approximations, this integral equation is transformed into the Schrödinger equation for a set of coupled harmonic oscillators, which can be solved. The energies and wave functions are obtained for the ground state and the low excited states of the system. The present approach is equivalent to the random phase approximation. (Contractor's abstract)

2008

Paris U. Lab. de Physique Théorique et Hautes
Energies, Orsay (France).

NON-LOCAL QUANTUM ELECTRODYNAMICS, by M.
Levy. [1964] [39]p. incl. diagrs. refs. (AFOSR-65-
0830) (AF EOAR-63-47) AD 600265   Unclassified

Also published in Nuclear Phys., v. 57: 152-190, 1964.

A gauge invariant non-local form of quantum electrody-
namics is constructed by introducing, in the interac-
tion Lagrangian, averages of the Dirac field operators
over time-like paths. It is shown that this theory leads
to convergent results to every order of perturbation
theory. Observable quantities are averaged subsequent-
ly over all possible time-like paths. The theory con-
tains a finite renormalization of the photon mass which
does not conflict with gauge invariance. The experi-
mental requirement that the physical mass of the photon
should vanish corresponds to an additional condition,
imposed by the parameters of the theory.

2009

Paris U. Lab. de Physique Théorique et Hautes
Energies, Orsay (France).

INTEGRAL EQUATION FOR CLASSICAL FLUIDS AND
THE LATTICE GAS, by D. Levesque and L. Verlet.
[1964] [2]p. incl. refs. (AFOSR-65-0831) (AF EOAR-
63-47) AD 632222   Unclassified

Also published in Phys. Ltrs., v. 11: 36-37, July 1,
1964.

Various integral equations have been proposed recently
to calculate the two-body correlation function of classi-
cal fluids. One of them, the so-called hypernetted
chain (HNC) equation, may be obtained either by sum-
ming the terms of the cluster expansion of the correla-
tion function which involve only convolution integrals or
by a new approximation scheme introduced by Percus.
In order to gain more insight on these equations, they
were applied to the lattice gas with an interaction
with the nearest neighbors.

2010

[Paris U.] Lab. de Physique Théorique et Hautes
Energies, Orsay (France).

THE RICCATI EQUATION AND REGGE POLES, by K.
Chadan and J. Y. Guennegues. [1964] [25]p. incl.
diagrs. refs. (AFOSR-65-1756) (AF EOAR-63-47)
AD 625355   Unclassified

Also published in Nuovo Cimento, Series X, v. 34:
665-689, Nov. 1, 1964.

The Schrödinger equation with a central potential is
transformed into a Riccati equation by the methods of
the theory of ordinary differential equations. The
equation is chosen in such a way that its solution, in
the limit $r \to \infty$, gives the scattering amplitude. By
studying the analyticity of the solution and of its limit,
information can be obtained on the domains in energy
and angular momentum where poles cannot lie. As it is
shown, the limitations obtained on the location of Regge
poles are very severe. For usual superpositions of
Yukawa potentials, poles in the λ-plane must lie in small
finite domains for all energies in a large region of the
complex plane. In particular, this region includes the
whole real positive energy axis. As a result, disper-
sion relations in momentum transfer need at most a fi-
nite number of subtractions. Finally, the amplitude is
shown to vanish when λ goes to infinity in the entire
right-hand half-plane, including the imaginary axis.

2011

Parma U. Inst. of Human Physiology (Italy).

PHYSIOLOGY OF CENTRAL VISUAL PATHWAYS, by
A. Arduini. Final rept. Dec. 31, 1964 [24]p. incl.
diagrs. table, refs. (AFOSR-65-0873) (AF EOAR-64-
38) AD 617572   Unclassified

The lateral geniculate nucleus and the visual cortex have
been considered on the basis of the linear systems
theory. An attempt has been made at determining their
transfer functions in conditions of retinal dark adapta-
tion and under stimulation with steady, diffuse, white
light of different intensity. The experiments have been
conducted in cats under barbiturate anesthesia, by
monitoring activity in the input and output fiber tracts to
these structures with both micro- and gross-electrodes.

2012

Parma U. Inst. of Human Physiology (Italy).

[RECORDING ACTIVITY IN THE CENTRAL VISUAL
PATHWAYS] Registrazione dell'attività nelle vie ottiche
centrali, by A. Arduini and G. Rizzolatti. [1964] [4]p.
(AFOSR-65-2967) (AF EOAR-64-38)   Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40:
885-888 [1964].

Activity in the retinogeniculate, geniculocortical, and
corticothalamic pathways has been compared in cats with
mid-pontine, and rostro-pontine pretrigeminal sections.
An electrode was inserted into the optic chiasma and
used to stimulate the cat with rectangular impulses.
Evoked responses were recorded with a bipolar elec-
trode consisting of two 0.1 mm diameter copper wires
in an uninsulated 0.5 mm diameter steel tube. Evoked
potentials in the corticifugal pathways not previously re-
corded with macroelectrodes were recorded with this
electrode. The authors have shown that it is possible
to record activity in the corticothalamic and thalamo-
cortical projections selectively when the activity is
represented as a discharge of impulses, rather than as
evoked potentials.

2013

Pennsylvania State U. [Dept. of Biology] University Park.

THE EFFECT OF CAROTENOID PIGMENTS ON PHO-
TOOXIDATIONS OF SOME PHOTOSYNTHETIC BAC-
TERIA, by L. A. Feldman and E. S. Lindstrom.
[1964] [7]p. (AFOSR-64-1649) (AF AFOSR-62-263)
AD 449976   Unclassified

Also published in Biochim. et Biophys. Acta, v. 79:
266-272, 1964.

The photooxidase activity of normal and carotenoidies
mutants of Rhodopseudomonas spheroides and Rhodo-
spirillum rubrum were compared. With Rhodopseudo-
monas, carotenoids were shown to act as accessory pig-
ment in indophenol photooxidation. The lack of caro-
tenoids resulted in a greater specific activity of the
photooxidase system. In Rhodopseudomonas, carote-
noids apparently function as an accessory pigment and
as a buffer for the photooxidant. With Rhodospirilium,
no accessory pigment function could be demonstrated in
indophenol photooxidation, and the absence of carote-
noids did not result in an increased photooxidase
activity.

2014

Pennsylvania State U. Dept. of Chemistry,
University Park.

STEREOCHEMICAL EVIDENCE FOR BRIDGED RADI-
CALS. PHOTOBROMINATION OF CIS- AND TRANS-4-
BROMO-T-BUTYLCYCLOHEXANE, by P. S. Skell and
P. D. Readio. [1964] [4]p. incl. refs. (AFOSR-66-
1036) (AF 49(636)457) AD 635642   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 66:
3334-3337, 1964.

Photobromination of cis-4-bromo-t-butylcyclohexane
(1) is a highly selective reaction, yielding trans-3-cis-
4-dibromo-t-butylcyclohexane (II). By contrast,
trans-4-bromo-t-butylcyclohexane is considerably less
reactive and less selective to attack by bromine atoms.
These results are interpreted in terms of bromine as-
sistance in the transistion state and a bridged radical
intermediate which opens in accord with the "diaxial
rule." This neighboring group effect is operative only
with a neighboring axial bromine. (Contractor's
abstract)

2015

Pennsylvania State U. Dept. of Chemistry,
University Park.

THE FREE-RADICAL ADDITION OF DEUTERIUM
BROMINE TO CIS- AND TRANS-1-DEUTERIO-I-
HEXENE, by P. S. Skell and P. K. Freeman. [1964]
[3]p. incl. refs. (AFOSR-66-1039) (AF 49(636)457)
AD 635639   Unclassified

Also published in Jour. Org. Chem., v. 29: 2524-
2526, 1964.

The radical-chain addition of deuterium bromide to a
terminal olefin, 1 deuterio-1-hexene, is a stereospecif-
ic reaction.

2016

Pennsylvania State U. Dept. of Chemistry,
University Park.

STEREOSPECIFIC TRANS PHOTOADDITION OF ELE-
MENTARY IODINE TO ALIPHATIC OLEFINS.
BRIDGED IODOALKYL RADICALS, by P. S. Skell
and R. R. Pavlis. [1964] [1]p. incl. diagrs. (AFOSR-
66-1042) (AF 49(636)457)   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 66:
2956, 1964.

Elementary iodine adds readily under illumination to 1-
butene, the 2-butenes, and isobutene at -40° to produce
colorless crystalline diiodides. The additions are
stereospecific trans. Bridged structures have been as-
signed to the iodoalkyl radical intermediates.

2017

Pennsylvania State U. [Dept. of Chemistry]
University Park.

PHYSICAL PROPERTIES OF ISOTOPICALLY SUBSTI-
TUTED FLUIDS, by W. A. Steele. Jan. 21, 1964 [9]p.
incl. illus. tables. (AFOSR-64-1417) (AF AFOSR-61-
27) AD 604468   Unclassified

The work consisted essentially in the design and con-
struction of a low temperature, high pressure density
balance and the associated equipment for the precise
measurement and control of temperature and pressure.
Some work was also done on the problem of purification
of the gases to be used in the balance. A balance was
constructed which appears to have the desired perform-
ance. The report is primarily concerned with a descrip-
tion of this apparatus and the problems met in its de-
sign and construction.

2018

Pennsylvania State U. Dept. of Chemistry,
University Park.

POLARIZATION OF NEAR ULTRAVIOLET ABSORP-
TION AND PHOSPHORESCENCE OF AROMATIC KE-
TONES, by V. G. Krishna. [1964] [9]p. incl. diagrs.
tables, refs. (AFOSR-65-0690) (AF AFOSR-62-39)
AD 615696   Unclassified

Also published in Jour. Molec. Spectros., v. 13: 296-
304, July 1964.

Polarizations of the phosphorescence ($T_1 \rightarrow S_0$) relative
to the lowest $\pi^* \leftarrow n$ and $\pi^* \leftarrow \pi$ absorption have been in-
vestigated in acetophenone, benzophenone, and anthrone.
The results indicate that the lowest triplet state is an
(n, π^*) state, the lowest singlet state is a ^1U state, and
that the lowest (π, π^*) state can be described analogous

to ^1L_b state in aromatic hydrocarbons. The $^1U - ^1A$ transition is allowed by the mixing of the ^1U state with (π, π^*) state of A_1 symmetry. In acetophenone and benzophenone the mixing of ^1U with ^1W also contributes to the $^1U - ^1A$ transition probability.

2019

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

MECHANISM OF FATIGUE IN CLOSE PACKED CRYSTALS, by M. A. Wilkov. Oct. 1963 [34]p. incl. illus. refs. (AFOSR-J1364) (AF AFOSR-62-273) AD 426562
Unclassified

Face-centered cubic materials of high and low stacking fault energy were fatigued at both room temperature and liquid nitrogen temperature. Observation of the mode of crack formation, using the electron microscope together with a process of successive replication, showed that the fatigue crack begins as a series of surface cavities which propagate and join to form a microcrack. Application of low temperature did not change this basic behavior except to make the cavity formation process more discrete and bear a closer resemblance to the void formations observed in high temperature creep. Such void formations have been attributed to a process of vacancy condensation. Based upon this observation, a low-temperature fatigue mechanism was proposed which utilizes the dislocation to sweep up point defects, created by the non-conservative motion of dislocation jogs, and deposit them on suitable nuclei on the external surface to form voids.

2020

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

ELASTIC-PLASTIC RESPONSE OF A SLAB TO A HEAT PULSE, by Y. -C. Lee and W. Jaunzemis. Mar. 1963, 155p. incl. diagrs. tables, refs. (Technical rept. no. 6) (AFOSR-4939) (AF AFOSR-63-128) AD 405691; AD 414201
Unclassified

The objective of the present study is to establish thermodynamically valid, non-isothermal stress strain relations for the elastic-plastic range, and to obtain solutions of typical one-dimensional problems involving unsteady temperatures. The entropy balance equation and the expression for production of internal entropy are considered. The limitations imposed by the second law of thermodynamics upon plastic flow rules are investigated, and a set of non-isothermal plastic stress strain relations is introduced. It is shown that these relations are in accord with thermodynamic irreversibility whenever the yield criteria of Tresca and von Mises are used. The stress strain relations of von Mises are a special case of the non-isothermal stress strain relations proposed here. Precise criteria for elastic loading and repeated plastic flow are presented, thus completing the characterization of the elastic-plastic response. The second part is concerned with an application of the general theory to a problem for the

infinite half-space constrained against lateral motion, and subjected to a heat pulse uniformly applied over its boundary.

2021

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

DIRECT OBSERVATIONS OF FATIGUE INDUCED DEFORMATION FAULTING IN THIN FOIL STAINLESS STEEL, by L. E. Murr and P. J. Smith. Final scientific rept. Jan. 1-Dec. 31, 1963. May 1964, 53p. incl. illus. diagrs. refs. (AFOSR-64-1004) (AF AFOSR-63-165) AD 602797
Unclassified

A study was made by transmission electron microscopy of thin foils of 304 stainless steel fatigued external to the electron microscope in reversed bending, and of thin foils fatigued directly within the microscope in alternating tension. The build-up of slip deformation striations and stacking faults in the thin foils during fatigue was correlated with the dislocation structures found in thin films prepared from fatigued bulk specimens. The performance of the special devices designed for fatigue of thin foils so outlined, and the importance of alternative methods of preparation of more uniform fatigue specimens by vapor deposition is emphasized. (Contractor's abstract)

2022

Pennsylvania State U. [Dept. of Engineering Mechanics] University Park.

A COMPARISON OF DISLOCATION ARRANGEMENTS IN STAINLESS STEEL FOILS, by L. E. Murr. [1964] [6]p. incl. illus. refs. (AFOSR-64-2241) (AF AFOSR-63-165) AD 452311
Unclassified

Also published in Appl. Materials Research, July 1964, p. 153-156.

The present work is an investigation of dislocation arrangements in thin metal foils produced by the direct deformation of the material inside and external to the electron microscope. The techniques employed demonstrate the feasibility of thin foil research, and the application of thin foil research to the dynamic analysis of deformation mechanisms in metals. With the present techniques, it is possible to observe directly deformation induced dislocation arrangements and to follow the change of events in imperfection arrangements and to follow the change of events in imperfection structure as the mode and frequency of deformation are altered.

2023

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

A CONTINUOUSLY PUMPED ULTRA-HIGH VACUUM-SORPTION SYSTEM FOR THE PREPARATION OF

HIGHLY ORDERED SINGLE-CRYSTAL METAL FOILS, by L. E. Murr. [1964] [6]p. incl. illus. diagrs. table. (AFOSR-65-0279) (AF AFOSR-63-165) AD 611612
Unclassified

Also published in Brit. Jour. Appl. Phys., v. 15: 1511-1515, 1964.

A simple sorption-type ultra-high vacuum system has been devised in which thin metal foils can be prepared quickly, with perfection and measurable reproducibility. Ultimate vacuum of 3×10^{-10} torr had been obtained using liquid nitrogen around the sorption, and evaporation chambers. Ultimate vacuum of 3×10^{-9} torr has been routine prior to evaporation of gold, silver, copper, and nickel foils which ranged in thickness from 500-2000 A. High purity single crystal silver foils have been repeatedly prepared in this system which are suitable for direct analysis of deformations by transmission electron microscopy. A comparison is made between the order and quality of these ultra-high vacuum prepared foils with foils prepared using commercially available high vacuum equipment. (Contractor's abstract)

2024

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

A LOW-TEMPERATURE FATIGUE TESTING MACHINE, by M. A. Wilkov and L. E. Murr. [1964] [3]p. incl. illus. diagr. (AFOSR-65-0260) (AF AFOSR-63-165) AD 611611
Unclassified

Also published in Materials Research and Standards, v. 4: 285-287, June 1964.

The machine is described as an extremely versatile mechanical system. The strain amplitude is adjustable over a wide range of measurable values, and the operating frequency is independent of the stress amplitude. Specimens can be fatigued in any liquid environment by the direct immersion of the specimen gripping section. A simple double-Dewar cryostat is used to contain a coolant that provides the low-temperature environment. The basic elements of the testing machine are an eccentric electric motor driving unit, a machined stainless-steel body, and a set of adjustable specimen grips.

2025

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

DYNAMIC ANALYSIS OF METALLIC DEFORMATION BY TRANSMISSION ELECTRON MICROSCOPY, by L. E. Murr. [1964] [18]p. incl. illus. diagrs. refs. (AFOSR-65-2476) (AF AFOSR-63-165) AD 627977
Unclassified

Also published in Proc. Pennsylvania Acad. Sci., v. 38: 126-143, 1964.

The paper describes techniques which enable thin metal foils to be deformed directly, and immediately observed in the electron microscope. The advantages of these dynamic testing methods are discussed, and typical observations of deformation as a result of fatigue, impact, and contact stressing are presented. Some consideration is also given to the theoretical interpretation of the imaging of defects by transmission electron microscopy. Selected area electron diffraction techniques are also employed to investigate the mechanism of contact stress fracture, which is directly observed in the electron microscope.

2026

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

EXPERIMENTAL AND ANALYTICAL STUDIES IN THEORY OF PLASTICITY WITH HYDROSTATIC STRESS EFFECT, by L. W. Hu. Final rept. Nov. 1, 1963-Oct. 31, 1964. Nov. 23, 1964, 5p. (AFOSR-64-2411) (AF AFOSR-64-127)
Unclassified

Accomplishments and progress are reported on the following 4 phases of the grant: (a) triaxial stress experiments on yield conditions of metals, (b) instrumentation for high pressure experiments, (c) plastic analysis of anisotropic plates, and (d) optimum weight design of pressure vessels for nuclear power reactors.

2027

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

PLASTIC ANALYSIS OF ORTHOTROPIC CIRCULAR PLATES, by J. Markowitz and L. W. Hu. [1964] [42]p. incl. diagrs. (AFOSR-64-2463) (AF AFOSR-64-127) AD 453741
Unclassified

Also published in Jour. Eng. Mech. Div., Proc. Amer. Soc. Civil Engineers, v. 90: 251-292, Oct. 1964.

The method of limit analysis is used to determine the load-carrying capacities of thin orthotropic circular plates composed of rigid-perfectly plastic material. It is assumed that the principal axes of anisotropy coincide at all points with the principal axes of stress and that the material obeys the modified Tresca yield condition and its associated flow rules. Investigation is restricted to rotationally symmetric types of loading and support. Design charts for ten loading conditions are constructed and an example is presented illustrating their use in the design of a pressure vessel head.

2028

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

TENSILE PLASTIC STRESS-STRAIN RELATIONS OF 2017-T4 ALUMINUM ALLOY UNDER HYDROSTATIC PRESSURE, by L. W. Hu and H. E. Shull. [1964] [2]p. incl. diagrs. table. (AFOSR-64-2464) (AF AFOSR-64-127) AD 453828
Unclassified

Also published in Jour. Appl. Mech., Sept. 1964.

For the aluminum alloy 2017-T4 tested in tension under hydrostatic pressures up to 50,000 psi, the following conclusions can be made: (1) The presence of hydrostatic pressure has no apparent effect on the strain-hardening coefficient n and the strength coefficient k of the tensile plastic stress-strain relations. (2) The necking of the specimen at fracture became more localized as the superimposed hydrostatic pressure increased. (3) The diameter at the neck of fractured specimens decreased as the intensity of hydrostatic pressure increased. Such variation was found to follow a linear relationship. (4) The reduction in area at fracture increased as the intensity of pressure increased.

2029

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

BASIC STUDY OF DISPERSION HARDENING FOR THE ATTAINMENT OF HIGH TEMPERATURE STRENGTH IN MATERIALS, by M. C. Inman, L. E. Murr, and P. J. Smith. Dec. 1964 [22]p. incl. illus. diagrs. tables. (AFOSR-64-2508) (AF AFOSR-64-669) AD 610393   Unclassified

Electron microscope studies of the substructure of nickel strengthened by dispersed particles of thoria were made. The particle size distribution of thoria in the 'as received' material was determined from electron transmission micrographs of thin films, as a basis for future studies of the effect of temperature upon size distribution and bulk strength. In addition, a color photography technique was developed which will be employed in studies of dispersed particles..

2030

[Pennsylvania State U. Dept. of Mathematics, University Park]

SOME PROPERTIES OF HARMONIC FUNCTIONS GENERATED BY THE BERGMAN-WHITTAKER OPERATOR, by J. Cima. [1963] [25]p. incl. refs. (AFOSR-65-0089) (AF AFOSR-62-59) AD 455926
                                        Unclassified

Also published in Ann. Mat. Pura Appl., v. 63: 175-199, 1963.

Properties of singular curves of harmonic functions generated by the Bergman-Whittaker operator are discussed and an analogue of the Eisenstein theorem for a certain class of such harmonic functions is obtained. (Contractor's abstract)

2031

Pennsylvania State U. Dept. of Physics, University Park.

NUMERICAL CALCULATIONS OF REFLECTION

COEFFICIENTS FOR DIFFERENT SURFACE POTENTIAL BARRIER MODELS, by P. H. Cutler, J. C. Davis, and J. J. Gibbons. [1963] [6]p. incl. diagr. table, refs. (AFOSR-J575) (AF AFOSR-61-100) AD 408017   Unclassified

Also published in Phys. Stat. Solidi, v. 3: K113-K118, 1963.

This note reports some results of numerical computations on the elastic scattering of slow electrons from different models of the surface potential barrier.

2032

Pennsylvania State U. [Dept. of Physics] University Park.

REFLECTION AND TRANSMISSION OF ELECTRONS THROUGH SURFACE POTENTIAL BARRIERS, by P. H. Cutler and J. C. Davis. Aug. 5, 1963, 21p. (AFOSR-64-1219) (AF AFOSR-61-100) AD 442847
                                        Unclassified

Also published in Surface Sci., v. 1: 194-212, 1964.

A numerical treatment has been made of the reflection properties of several 1-dimensional surface potential barrier models. Curves of reflection coefficient vs energy have been obtained for the classical image barrier, the modified or corrected image barrier and the Bardeen potential in both the zero and finite field cases. For zero field, the smoothly varying Bardeen potential yields smaller reflection except for energies close to zero. This result suggests that the presence of the discontinuous derivative in the potential function introduces spurious reflection. There is no appearance of the elastic scattering component found in low-energy electron diffraction for any of the 1-dimensional models investigated. With fields, the curves are qualitatively similar except near the barrier maximum. However, for incident energies above the barrier, the image and modified image are larger in magnitude then the Bardeen model. The present treatment is compared with a recent numerical computation of the periodic deviations in the Schottky effect.

2033

Pennsylvania State U. [Dept. of Physics] University Park.

THE EFFECT OF CORRELATION ON THE SURFACE POTENTIAL OF A FREE ELECTRON METAL, by T. L. Loucks and P. H. Cutler. [1964] [9]p. (AFOSR-64-1220) (AF AFOSR-61-100) AD 442925
                                        Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 105-113, 1964.

A one-electron Hamiltonian including correlation corrections is derived using the Bohm-Pines formalism. The total energy of the system is found using a product wave function of a plasmon ground state and a Slater determinant of one-electron wave functions. From this

one-electron Hamiltonian with correlation is developed
and applied to the calculation of the electronic potential
energy in the surface region of a free electron metal.
One term is the usual exchange integral except for the
appearance of a screening factor. The screened ex-
change potential is evaluated in the surface and interior
of the metal for several values of the screening parame-
ter and for two different forms of the screening factor.
It is found that the effect of correlation is to raise the
one-electron potential energy but that the general shape
near the surface remains similar to that found by
Juretschke.

2034

Pennsylvania State U. [Dept. of Physics]
  University Park.

BAND STRUCTURE AND FERMI SURFACE OF BERYL-
LIUM, by T. L. Loucks and P. H. Cutler. [1964] [11]p.
(AFOSR-64-1221) (AF AFOSR-61-100) AD 442848
                                                Unclassified

Also published in Phys. Rev., v. 133: A819-A829,
Feb. 3, 1964.

Using a self-consistent potential, the energy eigenvalues
along the symmetry edges, on the zone faces, and at the
equivalent of 5164 general points in the first Brillouin
zones were calculated for beryllium by expanding the
conduction electron wave functions in a linear combina-
tion of 23 orthogonalized plane waves. From this the
Fermi energy and density of states were calculated and
the Fermi surface constructed.

2035

Pennsylvania State U. [Dept. of Physics]
  University Park.

FURTHER RESULTS ON THE FERMI SURFACE OF
BERYLLIUM, by T. L. Loucks. [1964] [3]p.
(AFOSR-64-2107) (AF AFOSR-61-100) AD 451734
                                                Unclassified

Also published in Phys. Rev., v. 134: A1618-A1620,
June 15, 1964.

The conduction eigenvalues for beryllium at the equiva-
lent of over 80,000 points in the first Brillouin zone
(all in the immediate vicinity of the Fermi surface)
were calculated. The constant energy surfaces were
constructed for several values of the energy near the
Fermi energy. The hole and electron volumes were
calculated for each case, and the Fermi energy was
determined by the requirement that the two volumes be
equal. This is the first time that this well-known result
has actually been used to determine the Fermi energy
in a band calculation. The corresponding Fermi sur-
face was defined by about ten cross sections perpendicu-
lar to the (0001) direction. The agreement between
these results and experiment is generally good and
slightly improved over the previous results.

2036

Pennsylvania State U. [Dept. of Physics]
  University Park.

ULTRASONIC ATTENUATION IN THIN FILMS (Abstract),
by W. L. Ghering. [1963] [1]p. (AFOSR-65-1607)
(AF AFOSR-63-43)   Unclassified

Presented at Sixty-sixth Meeting of the Acoust Soc.
Amer., Ann Arbor, Mich., Nov. 6-9, 1963.

Also published in Jour. Acoust. Soc. Amer., v. 35:
1882, Nov. 1963.

When the physical shape of a liquid approaches a thin
film, the surface tension and configuration effects are
predominant in influencing the loss factor. In this paper
the effective loss factor of a number of liquids and semi-
solid substances is measured for various film thick-
nesses. The data show the effect of film thickness on
the loss factor and the effectiveness of the substance for
ultrasonic damping. The arrangement employed uses
parallel-mounted quartz crystals in tuned circuits. The
system is excited to resonance by a pulse and the re-
sponse and decay of the system are recorded. By means
of energy considerations, the effective loss factor of the
sample is determined.

2037

Pennsylvania State U. Dept. of Physics,
  University Park.

MEASUREMENT OF ULTRASONIC ATTENUATION IN
SOLIDS BY A REVERBERATION TECHNIQUE (Ab-
stract), by J. N. Lange. [1963] [2]p. (AFOSR-65-1608)
(AF AFOSR-63-43)   Unclassified

Presented at Sixty-sixth meeting of the Acoust. Soc.
Amer., Ann Arbor, Mich., Nov. 6-9, 1963.

Also published in Jour. Acoust. Soc. Amer., v. 35:
1883-1884, Nov. 1963.

A technique, similar to the method of measurement of
reverberation times in architectural acoustics, is in-
vestigated to provide accurate measurements of ultra-
sonic attenuation in solids. Sound is introduced into the
specimen through a quartz transducer excited by an rf
pulse. The radio frequency of the pulse is warbled and
the pulse duration is longer than the amount of time that
it takes for the initial wavefront to travel to one of the
reflecting surfaces of the specimen. Preliminary meas-
urements indicate a loss factor for aluminum approxi-
mately ten times less than previously measured, due to
the absence of any apparent attenuation due to grain
scattering.

2038

Pennsylvania State U. Dept. of Physics,
  University Park.

SEARCH FOR HIGH-Q LIQUID-FILLED SYSTEMS

(Abstract), by M. M. Simon. [1963] [1]p. (AFOSR-
65-1609) (AF AFOSR-63-43)   Unclassified

Presented at Sixty-sixth Meeting of the Acoust. Soc.
Amer., Ann Arbor, Mich., Nov. 6-9, 1963.

Also published in Jour. Acoust. Soc. Amer., v. 35:
1898, Nov. 1963.

The bulk modulus and its associated loss factor for
small viscoelastic specimens can be determined by
placing the sample at a velocity node of a liquid-filled
system. The Q of this system must be high in order to
obtain accurate results. Thus, to develop systems of
high Q with the aim in mind of eventually measuring
the Q of test specimens, the frequency response and Q
of several systems are determined, including tubes and
spheres of metal or glass containing liquids of various
viscosity and density.

2039

Pennsylvania State U. Dept. of Physics,
   University Park.

MEASUREMENT OF HIGH-Q RESONANCES IN
LIQUID-FILLED SPHERES (Abstract), by M. [M.]
Simon. [1964] [1]p. (AFOSR-65-1610) (AF AFOSR-
63-43)   Unclassified

Presented at [Sixty-eighth] Meeting of the Acoust Soc.
Amer., Austin, Tex., Oct. 1964.

Also published in Jour. Acoust. Soc. Amer., v. 36:
2000, Oct. 1964.

In order to measure the Q factor of a small solid speci-
men, a high-Q liquid-filled system must be obtained.
In this paper, a successful method is presented for ex-
citing the radial modes of a water-filled sphere sus-
pended in a vacuum. A small barium titanate crystal
is cemented to the end of a brass tube and placed at the
center of the sphere. Using this crystal for both driv-
ing and receiving, Q's as high as 72,000 are obtained
for several resonances in two water-filled spheres of
different wall thickness and diameter. Small samples
are placed at the center, and changes in the Q are
measured.

2040

Pennsylvania State U. [Dept. of Physics]
   University Park.

HIGH-Q QUARTZ-CRYSTAL SYSTEM FOR USE IN
ABSORPTION MEASUREMENTS (Abstract), by W. L.
Ghering. [1964] [1]p. (AFOSR-65-1611) (AF AFOSR-
63-43)   Unclassified

Presented at [Sixty-eighth] Meeting of the Acoust. Soc.
Amer., Austin, Tex., Oct. 1964.

Also published in Jour. Acoust. Soc. Amer., v. 36:
2000, Oct. 1964.

A high-Q resonant system employing an X-cut quartz

crystal is devised for use in absorption measurements
of small samples. To determine the constants of the
system, the Q of the system is measured under various
clamping and loading conditions. The clamping losses
are determined by comparing the system Q to the crys-
tal Q in free fall in a vacuum. The system Q is found
to be mainly a function of the clamping losses, and vari-
ous supporting methods are investigated. System Q's
in the order of 800,000 are obtained allowing the detec-
tion of the damping effect of a small sample or thin
film.

2041

Pennsylvania State U. Dept. of Physics,
   University Park.

PULSE PROPAGATION IN CYLINDERS AT THE
LOWER ULTRASONIC FREQUENCIES (Abstract), by
J. N. Lange. [1964] [1]p. (AFOSR-65-1613)
(AF AFOSR-63-43)   Unclassified

Presented at [Sixty-eighth] Meeting of the Acoust. Soc.
Amer., Austin, Tex., Oct. 1964.

Also published in Jour. Acoust. Soc. Amer., v. 36:
2000, Oct. 1964.

The presence of mode conversion at the lower ultrasonic
frequencies of wave propagation in a cylinder is not
presently understood. This paper discusses the origin
of mode conversion and its relation to the end reso-
nances as derived by McNiven. The roots of the Poch-
hammer-Chree frequency equation are reviewed critical-
ly with these phenomena.

2042

Pennsylvania State U. [Dept. of Physics]
   University Park.

FERMI STATISTICS OF TWO-DIMENSIONAL FREE-
ELECTRON SYSTEMS, by J. P. McKelvey and E. F.
Pulver. [1964] [13]p. (AFOSR-65-0174) (AF AFOSR-
63-73) AD 611497   Unclassified

Also published in Amer. Jour. Phys., v. 32: 749-761,
Oct. 1964.

The variation of the Fermi energy with temperature and
free-particle concentration is calculated analytically
for a number of two-dimensional systems, including the
free-particle gas, the intrinsic semiconductor and the
impurity semiconductor. The Fermi energy as a func-
tion of temperature and concentration is in some cases
calculated in closed form, while in other it is obtained
implicitly as the solution to a fairly simple transcenden-
tal equation. The physical significance of the variation
of Fermi energy as a function of temperature and con-
centration is discussed, and the deviation of the product
of the concentration of free electrons and holes for the
two-dimensional semiconductor from the Boltzmann
mass-action result is calculated and discussed in
detail.

2043

Pennsylvania State J. [Dept. of Physics]
University Park.

HIGH-TEMPERATURE TRANSITIONS IN RARE-EARTH
NIOBATES AND TANTALATES, by V. S. Stubican.
[1964] [4]p. (Rept. no. C-62-63) (AFOSR-64-1225)
(AF AFOSR-63-208) AD 442810   Unclassified

Also published in Jour. Amer. Ceram. Soc., v. 47:
55-58, Feb. 1964.

The high-temperature transition monoclinic/tetragonal
in the rare-earth tantalates and niobates with the for-
mula ABO_4 was investigated using a high-temperature
x-ray diffractometer. The transition was reversible
and proceeded by a gradual change in symmetry. The
temperature of the first appearance of the tetragonal
phase increased as the ionic size of the rare-earth ions
decreased and was considerably higher for the rare-
earth tantalates than for the rare-earth niobates. The
mechanism of the change is discussed.

2044

Pennsylvania State U. [Dept. of Physics]
University Park.

THE USE OF A NEW SURFACE POTENTIAL MODEL
IN THE THEORY AND FIELD EMISSION, by D. Nagy
and P. H. Cutler. [1964] [2]p. (AFOSR-64-1779)
(AF AFOSR-63-213) AD 449047   Unclassified

Also published in Phys. Ltrs., v. 10: 263-264, June
15, 1964.

The effect of a modified surface potential barrier on the
emitted current in the field emission regions was stud-
ied. The resulting current density curve exhibits the
same high field deviations found experimentally. The
model of the surface barrier is the same used by Cut-
ler and Gibbons in their recent work on the theory of
the thermionic periodic deviations in the Schottky ef-
fect. The potential is essentially a quantum modifica-
tion of the classical image force and is based on quan-
tum mechanical calculations of the electronic potential
in the surface region of a metal.

2045

Pennsylvania State U. [Field Emission Lab.]
University Park.

BOMBARDMENT OF TUNGSTEN WITH 20-KEV HELI-
UM ATOMS, by M. K. Sinha and E. W. Muller. [1964]
[6]p. (AFOSR-64-1212) (AF AFOSR-62-96) AD 443018
                                Unclassified

Also published in Jour. Appl. Phys., v. 35: 1256-
1261, Apr. 1964.

Fast He atoms are shot into one side of the tungsten
emitter tip of a field ion microscope, and the resulting
damage to the surface, consisting of vacancies, inter-

stitials, and their clusters, is observed in atomic reso-
lution. About one-half of the number of atoms calculat-
ed to have received a displacement energy of 50 ev
in the interior appear as surface defects. The surface
integrates the damage by focusing collisions coming
from as deep as 1000 A. Stress enhanced mobility of
subsurface interstitials is detectable at 21°K, and rapid
thermal diffusion from the depth occurs at 90°K.

2046

Pennsylvania State U. [Field Emission Lab.]
University Park.

FIELD ION MICROSCOPY OF RHENIUM, by E. W.
Muller. [1964] [2]p. incl. illus. (AFOSR-65-0778)
(AF AFOSR-62-96) AD 617834   Unclassified

Also published in Proc. Third European Regional Conf.
on Electron Microscopy, Prague (Czechslovakia), 1964
p. 161-162.

This note examines the ion microscopic image of rheni-
um. Features of the ion image discussed are the evap-
oration field at 20°K, the intensity alternation of net
plane rings around the 0091 pole, the decoration by the
bright atoms of six [21$\bar{1}$0] zone lines emerging radially
from the 0001 plane, the existence of a high dislocation
density in a concentric area 20 to 30° off the c-axis,
and the adsorption of residual gas. Illustrations of ion
images of rhenium are presented.

2047

Pennsylvania State U. [Field Emission Lab.]
University Park.

THE EFFECT OF POLARIZATION, FIELD STRESS,
AND GAS IMPACT ON THE TOPOGRAPHY OF FIELD
EVAPORATED SURFACES, by E. W. Muller. [1964]
[11]p. incl. illus. refs. (AFOSR-65-0780)
(AF AFOSR-62-96) AD 617242   Unclassified

Also published in Surface Sci., v. 2: 484-494, 1964.

Field evaporation of pure metals can produce highly
perfect surfaces. The field evaporation end form is es-
tablished by balancing the local field at the evaporation
site with the binding energy of the evaporating metal
atom. A considerable part of this energy is due to po-
larization which can be described by field penetration
rather than by the polarizability of the free atom. Po-
larization also stabilizes characteristic low-coordina-
tion sites. In several metals the field stress causes
specific lattice defects. The field evaporation end form
is further modified by the presence of the imaging gas
when the molecules effectively transfer their dipole at-
traction energy in the collision with surface atoms.
(Contractor's abstract)

2048

Pennsylvania U. [Dept. of Linguistics] Philadelphia.

ON ENGLISH PRONOUNS AND THEIR VERBAL

AGREEMENT, by A. F. Brown. Sept. 1963, 32p.
(AFOSR-64-0948) (AF AFOSR-64-477) AD 600220
Unclassified

An attempt is made to cover all the crucial environ-
ments and to set up a minimal but sufficient number of
morphemic components to account for the occurrence
of pronominal forms in these environments, or, con-
versely, to account for the effect of these pronominal
forms upon their environments.

2049

Pennsylvania U. [Dept. of Linguistics] Philadelphia.

THE DISCONTINUOUS VERB IN ENGLISH, by A. H.
Live. Oct. 1963, 23p. (AFOSR-64-0950) (AF AFOSR-
64-477) AD 600219   Unclassified

A discussion is given of discontinuous verbs from the
point of view of a few consistent syntactic patterns, in-
volving transitivity, passive transformation, word or-
der, and relative stress.

2050

[Pennsylvania U. Dept. of Linguistics, Philadelphia]

ENGLISH CANONICAL FORMS AND STYLE LEVELS,
by A. F. Brown. Sept. 1964 [62]p. incl. tables, refs.
(AFOSR-64-1666) (in cooperation with Lehigh U.,
Bethlehem, Pa.) (AF AFOSR-64-477) AD 607376
Unclassified

In an effort to characterize different levels of style in
spoken and written English, one element of style - the
lexical material - is examined. There appears to be a
general association of borrowed lexical material with
formal styles, and of native lexical material with in-
formal styles. Also, there is evidence that, while
some proportion of loan forms have been well-natural-
ized into native English shapes and may be not dis-
tinguishable as loans, a large number of loan forms
still have shapes which set them off from native forms.
Some proper names and verb forms are examined as
samples of the lexical material. The relation of vari-
ants of some proper names to levels of style is dis-
cussed, as well as the relation of native vs loan verbs
to levels of style.

2051

Pennsylvania U. [Dept.] of Metallurgical Engineering,
Philadelphia.

A NEW THEORY OF WORK HARDENING IN CRYS-
TALS, by D. Kuhlmann-Wilsdorf. [1963] [17]p. incl.
refs. (AFOSR-4005) (AF 49(636)435) AD 290692
Unclassified

Presented at Internat'l. Conf. on Crystal Lattice De-
fects, Tokyo and Kyoto (Japan), Sept. 3-4, 1962.

Also published in Jour. Phys. Soc. Japan, v. 16: 68-
73, Mar. 1963.

The three stages of the usual work hardening curve of
fcc metals, easy glide, stage II, and stage III, are ex-
amined theoretically. The manifold and complex ob-
servations regarding easy glide may be understood from
the idea that easy glide is the stage during which dislo-
cations move and multiply, spreading throughout the
specimen until a quasi-uniform dislocation density,
commensurate with the applied stress, has been estab-
lished. The cause for the amazingly consistent ratio of
θ_{II}, the work-hardening coefficient during stage II, to
G, the modulus of rigidity, such that $G/\theta_{II} = K \sim 300$ is
investigated. Stage II is explained on the basic assump-
tion that multiplication and movements of dislocations
take place in such a manner that the dislocation con-
figurations first established change in scale only, but
not in character. Stage III is understood to commence at
the onset of additional modes of dislocation motion,
besides slip, be it climb, or cross slip or both. The
dislocation pattern then changes in character.

2052

Pennsylvania U. Dept. of Metallurgical Engineering,
Philadelphia.

EXPERIMENTAL VERIFICATION OF THEORIES ON
DISLOCATION BEHAVIOUR OF STRAINED F.C.C.
METALS, by D. Kuhlmann-Wilsdorf, H. J. Levinstein
and others. [1963] [13]p. incl. illus. diagrs. refs.
(AFOSR-J1102) (AF 49(636)435)   Unclassified

Also published in Jour. Australian Inst. Metals, v. 6:
102-114, May 1963.

In a recent investigation, based on a high-resolution
etch-pitting technique, the dislocation distribution in
strained silver single crystals was examined. Several
new results of considerable interest were obtained. A
careful analysis and comparison of these, and of pre-
vious results, shows them to disprove theories on the
phenomenon of dislocation tangling which are built on
the assumption that either cross-slip or dislocation in-
tersections are the decisive mechanism. Also dis-
credited are theories of work-hardening based on dislo-
cation jogs or long-range stresses as responsible for
the greater part of work-hardening in stage II. By
contrast, the basic hypotheses and major conclusions of
the theory of "mushrooming", and the theory of work-
hardening by one of the authors (D. K. W.), are in
striking agreement with all the results. This is inter-
preted as constituting a virtual proof of the basic frame-
work of these theories. (Contractor's abstract)

2053

Pennsylvania U. [Dept. of Metallurgical Engineering]
Philadelphia.

DISLOCATION MOVEMENTS AND DISLOCATION AR-
RAYS, by D. [Kuhlmann-] Wilsdorf. Final rept. June
1, 1958-Aug. 31, 1963. Sept. 19, 1963, 15p. incl.
refs. (AFOSR-J1125) (AF 49(638)435) AD 421195
Unclassified

In an effort towards the understanding of deformation

bands, single crystals of aluminum were grown oriented for single slip, in the form of wavy ribbons. Since the bands were to be studied in all phases of development, it was necessary to search for methods for the early detection and quantitative examination of deformation bands. Experiments in this direccion, employing the Berg-Barrett x-ray method were begun. Contrary to expectations, polygonization behavior strongly depends on the relative position of any given volume element in a specimen. A noteworthy observation was that the angular misorientation associated with a wall does not ordinarily change on annealing.

2054

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

CONTRIBUTIONS TO THE CRYSTAL CHEMISTRY OF NORMAL AND DEFECT TETRAHEDRAL STRUC-TURES, by E. Parthe. [1963] [21]p. (AFOSR-64-0760) (AF 49(636)1027) AD 436490   Unclassified

Also published in Zeitschr. Krist., v. 119: 205-225, 1963.

A scheme has been developed which allows one to calculate the compositions of all thecretically possible normal and defect tetrahedral structures. Some 200 tetrahedral-structure compounds are known which all fit in the composition scheme.

2055

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

Sc_5Ga_3 AND Y_5Ga_3 WITH $D8_6$ STRUCTURE, by O. Schob and E. Parthe. [1964] [2]p. incl. table. (AFOSR-65-0770) (AF 49(636)1027) AD 617209 Uncla   Unclassified

Also published in Acta Cryst., v. 17: 1335-1336, Oct. 1964.

In the continuation of an investigation on the occurrence of compounds with $D8_6$ structure, the phases $Sc_5 Ga_3$ and Y_5Ga_3 have been synthesized. Induction melting of the metals mixed in proper weight proportions in a boron nitride crucible under argon has given homogeneous samples of $Se_5 Ga_3$ and Y_5Ga_3. Including these 2 compounds the total number of known $D8_6$ phases is 46.

2056

Pennsylvania U. [Office of Computer Research and Education] Philadelphia.

A SYNTAX-ORIENTED COMPILER FOR LANGUAGES WHOSE SYNTAX IS EXPRESSIBLE IN BACKUS NOR-MAL FORM AND SOME PROPOSED EXTENSIONS

THERETO, by P. Z. Ingerman. Master's thesis, May 1963, 1v. (AF 49(636)951) AD 419103
Unclassified

A syntax-oriented compiler for languages with a context-free syntax expressed in Backus Normal Form is discussed. The technique discussed is applicable to an iterated compilation process, where each phase of the compilation generates the rules of syntax required for the next phase of the compilation. Complcte flow charts are included for the major processors; these flow charts are essentially machine-independent. Also included is a discussion of the extensions required which allow the compilation technique to be extended to context-dependent syntax, although a non-terminating compilation may result in certain cases if these extensions are included.

2057

Pennsylvania U. School of Medicine, Philadelphia.

NEUROHUMORAL CONTROL OF THE PITUITARY, by S. M. McCann. Final rept. Aug. 1, 1962-July 31, 1963. Dec. 4, 1963, 6p. (AFOSR-J1373) (AF AFOSR-62-133) AD 426402   Unclassified

The objective of this work has been to clarify the hypothalamoanterior hypophysial interrelationship. Work has been done in two areas: (1) regulation of ACTH secretion, and (2) regulation of the secretion of gonadotrophins.

2056

Pennsylvania U. School of Medicine, Philadelphia.

A HIGHLY SENSITIVE TEST FOR LH-RELEASING AC-TIVITY THE OVARIECTOMIZED, ESTROGEN PRO-GESTERONE-BLOCKED RAT, by V. D. Ramirez and S. M. McCann. [1963] [6]p. incl. diagrs. tables, refs. (AF AFOSR-62-133) AD 427576   Unclassified

Also published in Endocrinology, v. 73: 193-198, Aug. 1963.

The LH-releasing effect of crude acidic extracts of rat stalk-median eminence tissue was evaluated in chronically ovariectomized rats in which LH secretion had been partially blocked by injection of estrogen and progesterone. Ten min after intravenous administration of these extracts a significant increment in plasma LH was detectable, as measured by the ovarian ascorbic acid depletion test. The minimal effective dose (MED) of stalk-median eminence extract was approx 40 μg wet weight of tissue extracted. By contrast, cerebral cortical extract was completely inactive at doses up to 5,000 μg wet weight of tissue extracted. The quantity of Pitressin required to produce a positive response is approx 200-400 times greater than the quantity of vasopressin found in the MED of hypothalamic extract. The MED for epinephrine was 5 μg, a quantity several thousand times the amount present in the MED of stalk-median eminence. (Contractor's abstract)

2059

Pennsylvania U. School of Medicine, Philadelphia.

PURIFICATION OF LUTEINIZING HORMONE-RE-
LEASING FACTOR FROM BEEF HYPOTHALAMUS, by
V. D. Ramirez, R. Nallar, and S. M. McCann. [1964]
[5]p. (AFOSR-64-1708) (AF AFOSR-62-133)
AD 448266   Unclassified

Also published in Proc. Soc. Exper. Biol. and Med.,
v. 115: 1072-1076, 1964.

Experimental work from a number of laboratories has
convincingly demonstrated a gonadotrophin-releasing
action of extracts from the stalk-median eminence re-
gion of several species. Campbell et al showed that
direct injection of crude acidic extracts of beef stalk-
median eminence into the anterior lobe of the pituitary
of rabbits would evoke ovulation, and similar results
were obtained in the rat by Nikitovitch-Winer. More
recently, Johnson has obtained ovulation in androgen-
sterilized rats after intravenous injection of beef hy-
pothalamic extracts. Since the LH-releasing activity
was diminished by peptic and eliminated by tryptic
digestion, it was concluded that the LH-releasing fac-
tor (LH-RF) was a polypeptide.

2060

Pennsylvania U. School of Medicine, Philadelphia.

EFFECT OF ESTRADIOL IMPLANTS IN THE HYPO-
THALAMOHYPOPHYSIAL REGION OF THE RAT ON
THE SECRETION OF LUTEINIZING HORMONE, by
V. D. Ramirez, R. M. Abrams, and S. M. McCann.
[1964] [6]p. (AFOSR-64-2157) (AF AFOSR-62-133)
AD 452041   Unclassified

Bilateral implants of estradiol or estradiol diluted
with cholesterol were placed in various parts of the
brain or pituitary of ovariectomized rats. Implants of
estradiol in either the median eminence region or the
anterior lobe of the pituitary prevented the post-
castration rise of plasma luteinizing hormone (LH).
The minimal effective dose of implanted estradiol to
lower plasma LH was approx the same whether the im-
plant was located in the median eminence or pituitary
gland. Median eminence implants lowered hypophysial
LH content, whereas hypophysial implants did not. Im-
planted estradiol in both these loci also enlarged the
anterior lobe of the hypophysis.

2061

Pennsylvania U. School of Medicine, Philadelphia.

THE EFFECTS ON ACTH AND GONADOTROPHIN SE-
CRETION OF IMPLANTS OF GONADAL STEROIDS
IN THE HYPOTHALAMO-HYPOPHYSIAL REGION, by
L Chowers and S. M. McCann. [1963] [13]p.
(AFOSR-64-2158) (AF AFOSR-62-133) AD 452039
                                             Unclassified

Also published in Israel Med. Jour., v. 22: 11-12,
420-432, Nov.-Dec. 1963.

Implants of testosterone and estradiol into the median
eminence (ME) and mammilary bodies (MB) produced a
decrease in weight of seminal vesicles and ventral pros-
tate on comparison with weights found in normal or
cholesterol-implanted controls. Since peripheral injec-
tion of testosterone was associated with an increased
weight of the accessory sexual organs and since im-
plants of gonadal steroids in a variety of other loci in
the hypothalamo-pituitary region were without effect,
it is suggested that the action of the effective implants
is a local one on cells specifically sensitive to the
steroids. Gonadal hormones implanted in the anterior
pituitary and MB also caused a significant increase in
adrenal weight when compared to the unimplanted or
cholestrol-implanted rats. Estradiol implants in the
ME also increased adrenal weight; however, testos-
terone was without effect on adrenal weight in this locus.

2062

Pennsylvania U. School of Medicine, Philadelphia.

THE NEUROENDOCRINE REGULATION OF HYPO-
PHYSEAL LUTEINIZING HORMONE SECRETION, by
S. M. McCann and V. D. Ramirez. 1964, 51p.
(AFOSR-64-2479) (AF AFOSR-62-133) AD 453820
                                             Unclassified

Also published in Recent Progress in Hormone Re-
search, v. 20: 131-181, 1964.

This review presents an overall picture of the regula-
tion of luteinizing hormone (LH) secretion and syn-
theses. Nearly all results reported are based on the
ovarian ascorbic acid depletion assay, with a brief de-
description of this method. This is followed by considera-
tion of the factors that influence LH secretion in the
normal and castrate rat, and, finally, by a discussion
of the neural control of secretion of this trophin.

2063

Pennsylvania U. School of Medicine, Philadelphia.

HYPOTHALAMIC FSH AND LH-RELEASING FACTORS,
by S. M. McCann, V. D. Ramirez, and M. Igarashi.
[1964] [12]p. incl. diagrs. table, refs. (AFOSR-65-
1508) (AF AFOSR-62-133) AD 624005   Unclassified

Presented at Brook Lodge Conf. on Proteins and
Polypeptides, Kalamazoo, Mich., Oct. 7-9, 1963.

Also published in Metabolism, v. 13: 1177-1189, Oct.
1964.

The stalk-median eminence of the hypothalamus appears
to contain a luteinizing hormone-releasing factor, LH-
RF, which is a small, active polypeptide with mol wt
less than 3500, and is dissimilar from known neurohy-
pophysial hormones and corticotrophin-releasing fac-
tors. Hypothalamic control over LH secretion also ap-
pears to be mediated by means of secretion of LH-RF
into hypophysial portal vessels. It remains to be de-
termined if the LH-RF and follicle stimulating hor-
mone-releasing factor are distinct entities or part of a
gonadotrophin-releasing complex.

2064

Pennsylvania U. School of Medicine, Philadelphia.

THIOGLYCOLLATE-STABLE LUTEINIZING HOR-
MONE AND CORTICOTROPHIN-RELEASING FAC-
TORS, by V. D. Ramirez and S. M. McCann. [1964]
[5]p. incl. diagrs. tables, refs. (AFOSR-65-1510)
(AF AFOSR-62-133) AD 623496   Unclassified

Also published in Amer. Jour. Physiol., v. 207: 441-
445, Aug. 1964.

Crude acidic extracts of beef stalk-median eminence
tissue depleted ovarian ascorbic acid on injection into
immature rats pretreated with gonadotrophins. They
also elevated plasma luteinizing hormone (LH) activity
in ovariectomized rats which had been pretreated with
both estrogen and progesterone. It is concluded that
beef stalk-median eminence tissue contains a specific
LH-releasing factor (LH-RF). These same extracts
possessed an ACTH-releasing action, as judged by
adrenal ascorbic acid depletion induced in rats with
median eminence lesions, which could not be accounted
for by the minimal contamination of the extract with
ACTH itself. It is concluded that the LH-RF and corti-
cotrophin-releasing factor resident in beef hypothalamic
tissue are dissimilar from the known neurohypophysial
polypeptides.

2065

Pennsylvania U. School of Medicine, Philadelphia.

COMPARISON OF EFFECT OF ENVIRONMENTAL
AND PREOPTIC COOLING ON PLASMA CORTISOL
LEVELS, by I. Chowers, H. T. Hammel and others.
[1964] [6]p. incl. diagrs. table, refs. (AFOSR-65-
1511) (AF AFOSR-62-133) AD 623293   Unclassified

Also published in Amer. Jour. Physiol., v. 207:
577-582, Sept. 1964.

The acute exposure of dogs to an environmental tem-
perature of 0°C evoked an elevation in plasma cortisol
concentration which was apparent within 15 min and
persisted for the 45 min of exposure. Gradual cool-
ing of the environment over a 45-min period to a mini-
mal temperature of 0°C failed to elevate plasma corti-
sol concentrations, although other compensatory
mechanisms such as cutaneous vasoconstriction were
active. Acute lowering of preoptic temperature also
evoked a rise in plasma cortisol concentrations as-
sociated with lowering of pinna and elevation of rectal
temperature. In this case the response was transient;
plasma cortisol levels began to fall after 15 min of
cooling even though cutaneous vasoconstriction was
maintained. The results are interpreted to mean that
acute lowering of environmental or preoptic tempera-
ture can activate the pituitary-adrenal system. (Con-
tractor's abstract)

2066

Pisa U. (Italy).

NEUROPHYSIOLOGICAL STUDIES OF CONDITIONING,
by G. Ricci. May 1, 1963, 1v. (AFOSR-4884)
(AF EOAR-62-102) AD 415115   Unclassified

Atropine, in doses with little or no effect on the EEG
arousal, impaired the acquisition of conditioned
responses (CR) in the naive monkey and caused a de-
creased generalization of the responses to the negative
stimulus in well trained animals. In doses sufficient to
block the EEG arousal, atropine also caused a disap-
pearance of the CR. In these animals both the EEG
arousal and the conditioned responses could be restored
by administering eserine. A dissociation between EEG
and conditioned responses could be found in the monkey
only when amphetamine was given in animals previously
treated with atropine. A slight pupillary constriction
was found to occur during the first part of the condi-
tioned trial. The facilitation of the visual cortical
responses observed during conditioning was found to
occur during both the pupillary constriction and the
first part of the following period of pupillary dilatation.

2067

Pisa U. [Dept. of Mathematics] (Italy).

[THE MINIMUM PRINCIPLE IN THE CALCULUS OF
VARIATIONS] Il principio di minimo nel calcolo delle
variazione, by G. Stampacchia. [1964] 20p. incl. refs.
(AFOSR-65-1031) (AF EOAR-63-29) AD 619541
                                        Unclassified

Also published in Atti Simposio Lagrangiano, Torino
(Italy) [Apr.] 1964, p. 1-20.

This note reports developments of the minimum princi-
ple in the theory of elliptic partial differential
equations.

2068

Pisa U. [Dept. of Mathematics] (Italy).

[ANALYTIC METHODS FOR ABELIAN VARIETIES OF
POSITIVE CHARACTERISTIC. PARTS 1, 2] Metodi
analitici per varietà abeliane in caratteristica positiva.
Capitoli 1, 2, by I. Barsotti. July 17, 1963, 28p.
(AFOSR-65-2731) (AF EOAR-63-29) AD 627550
                                        Unclassified

Also published in Ann. Scuola Norm. Super. Pisa, v.
18: 1-25, 1964.

This paper is devoted to an extension of the theory of
Witt vectors. First Cov R (the Witt covectors) is in-
troduced as the set of sequences $(\cdots, x_{-2}, x_{-1})$ from R
satisfying a suitable convergence condition. Like the
Witt vectors, they are added by certain universal
formulas for the components, and there are natural
operators t, π, and p on them. Cov R is a topological
(Vect k)-module. The bivectors $(\cdots, x_{-1}, x_0, x_1, \cdots)$

are then defined as those sequences for which $(\cdots, x_n)$ is a covector for all n. They form a topological group which is completable to Biv R. This last is a complete topological ring, as well as a topological (Vect KR)-module. Finally, the topology in R permits the introduction of analysis--the exponential, logarithmic and Artin-Hasse exponential series are introduced and briefly studied.

2069

Pisa U. [Inst. of Aeronautics] (Italy).

LINEARIZED SUPERSONIC FLOW OF A JET IN A SUPERSONIC STREAM AT AN ANGLE OF ATTACK, by E. Pistolesi and M. Marini. Mar. 1963, 31p. (AFOSR-4825) (AF EOAR-62-97) AD 407027
Unclassified

Within the linearized theory, a method has been found to study the flow in a supersonic jet on a wing disposed in a supersonic stream based on the use of particular singularities, called 'pseudodoublets' disposed on the jet axis. A method has also developed the study of the characteristics of the flow around a cylindrical duct of finite length at an angle of attack to obtain results easily suitable for the application of the proposed method. A detailed development of the proposed method giving the complete results for the flow in the jet and in the external stream is presented.

2070

Pisa U. Inst. of Physiology (Italy).

OCULAR MOVEMENTS IN THE MIDPONTINE PRE-TRIGEMINAL PREPARATION, by F. A. King and P. L. Marchiafava. [1963] [12]p. (AFOSR-J611) (AF 61(052)107) AD 632622; AD 414020
Unclassified

Also published in Arch. Ital. Biol., v. 101: 149-160, 1963.

The original purpose of this study was to examine further the suggestion that the midpontine pretrigeminal preparation with a consistently low voltage, fast EEG is actually awake by determining what correlations exist between type of EEG pattern and vertical optokinetic nystagmus. It was found, however, that complete transection results in a total loss of the optokinetic reflex regardless of the form of cortical electrical activity. Inasmuch as the pretrigeminal preparation still responds to objects moving in the visual field by vertical following eye movements, the lack of optokinetic nystagmus is not interpreted as an indication that the animal is actually not awake. It is hypothesized that interference with reflex circuitry may account for the failure of the optokinetic reflex. Findings indicate that vertical optokinetic nystagmus and vertical following movements require different central mechanisms and stimulus conditions for their elicitation.

2071

Pisa U. Inst. of Physiology (Italy).

PONTINE RETICULAR FORMATION: RELATION TO LATERAL GENICULATE NUCLEUS DURING DEEP SLEEP, by E. Bizzi and D. C. Brooks. [1963] [3]p. (AFOSR-J1324) (AF 61(052)107) AD 424524; AD 632623
Unclassified

Also published in Science, v. 141: 270-272, July 19, 1963.

Irregular groups of monophasic waves (seven waves per sec) appear synchronously in the pontine reticular formation and in the lateral geniculate nucleus during the deep (low-voltage, fast) phase of sleep. The geniculate potentials can be triggered by low-rate stimulation of the pontine reticular formation, but the reverse effect has never been obtained.

2072

Pisa U. Inst. of Physiology (Italy).

PYRAMIDAL ACTIVITY DURING SLEEP AND WAKE-FULNESS, by A. Arduini, G. Berlucchi, and P. Strata. [1963] [15]p. (AFOSR-J1325) (AF 61(052)107) AD 424233; AD 632624
Unclassified

Also published in Arch. Ital. Biol., v. 101: 530-544, 1963.

Results of this study may be summarized as follows. During wakefulness the pyramidal discharge attains a quasi steady value, provided that the animal does not accomplish large movements. During the stage of sleep characterized by EEG with high voltage, low frequency waves and activity still present in the neck muscles, the mean level of pyramidal activity is noticeably lower than during wakefulness. Peaks of discharge, synchronous with the spindle trains of the EEG, characterize the pyramidal activity in this stage. Corresponding to the transition from the phase of sleep just described to the 'fast' type of sleep, with low amplitude, fast EEG waves and muscular atonia, the base line of the pyramidal record rises to a level equal to, or higher than, that reached during wakefulness. This level is maintained throughout this stage, with some short-lasting peaks of discharge synchronous with the muscular twitches.

2073

Pisa U. [Inst. of Physiology] (Italy).

EEG-ACTIVATING INFLUENCES IN THE CERVEAU ISOLE PREPARATION, by G. Moruzzi. [1963] [5]p. (AFOSR-J1327) (AF 61(052)107) AD 424223; AD 632619
Unclassified

Also published in Perspectives in Biology, New York, Elsevier Publishing Co., 1963, p. 434-438.

The experiments suggest that tonically active desynchronizing structures are present in the isolated

cerebrum following post-collicular transection. These structures would be driven reflexively by a tonic retinal inflow, which in the complete absence of light obviously corresponds to the retinal dark discharge. It is likely that the behavioral and EEG activation following chronic midbrain transection is due to a compensatory enhancement of the tonic discharge of these structures, which in the acute preparation would simply counteract, but never overwhelm, the strong tendency to synchronization of the cerveau isole. The same explanation might hold true for the predominance of low-voltage fast activity in the chronic cerveau isole dog.

2074

Pisa U. Inst. of Physiology (Italy).

FUNCTIONAL CONNECTIONS BETWEEN PONTINE RETICULAR FORMATION AND LATERAL GENICULATE NUCLEUS DURING DEEP SLEEP, by E. Bizzi and D. C. Brooks. [1963] [25]p. (AFOSR-J1328) (AF 61(052)107) AD 424222; AD 632621
Unclassified

Also published in Arch. Ital. Biol., v. 101: 666-680, 1963.

The waves present in the pontine reticular formation and the lateral geniculate nucleus during deep sleep were found to be synchronous. Low frequency (2/sec or less) stimulation of the pons at the level of the nucleus reticularis pontis caudalis led to a response in the lateral geniculate nucleus which consisted of either a single wave or a group of 2-3 waves. During deep sleep, synchronized sleep and arousal it was impossible by stimulating the lateral geniculate nucleus to produce pontine responses resembling deep sleep waves. Deep sleep waves could not be recorded from the optic chiasm and optic tract. Deep sleep waves were still present in the lateral geniculate nucleus of animals in which the visual cortex had been removed.

2075

Pisa U. Inst. of Physiology (Italy).

THE EFFECTS OF FLICKER AND STEADY ILLUMINATION ON THE ACTIVITY OF THE CAT VISUAL SYSTEM, by A. Arduini and L. R. Pinneo. [1963] [22]p. (AFOSR-J1329) (AF 61(052)107) AD 424110; AD 632620
Unclassified

Also published in Arch. Ital. Biol., v. 101: 508-529, 1963.

The amount of activity of the optic chiasm and dorsal nucleus of the lateral geniculate body, was measured in response to flickering light alone, steady light alone, and combinations of flicker and steady illumination. Animals were nembutal anesthetized and awake chronically prepared cats. Activity of the visual system was found to be increased over the level of the dark discharge by low frequency flickering light, but was substantially depressed below the level of dark discharge with high frequencies of flicker. In general, the drop in tonic activity was linearly related to flicker

frequency, but tended to reach a steady level at the highest frequencies. The final level of activity at the highest frequencies was slightly higher than the level produced by steady illumination of the same intensity.

2076

Pisa U. Inst. of Physiology (Italy).

BRAIN STEM ELECTRICAL ACTIVITY DURING DEEP SLEEP, by D. C. Brooks and E. Bizzi. [1963] [18]p. (AFOSR-J1330) (AF 61(052)107) AD 424234; AD 632618
Unclassified

Also published in Arch. Ital. Biol., v. 101: 648-665, 1963.

In the sleeping cat, frequent discrete episodes of deep sleep were observed, during which the cortical EEG developed low voltage fast activity, the posterior cervical EMG became flat, and erratic eye movements were recorded. Theta activity was consistently recorded from the hippo-campus during deep sleep. During deep sleep a distinctive pattern of electrical activity was recorded from three regions: a broad zone of the pons at the level of the nucleus reticularis pontis caudalis, the oculomotor nucleus and the lateral geniculate nucleus. This pattern, which has been termed deep sleep wave activity, consisted of intermittent groups of essentially monophasic waves having a rather uniform amplitude.

2077

Pisa U. Inst. of Physiology (Italy).

THE TONIC ACTIVITY OF THE LATERAL GENICULATE NUCLEUS IN DARK AND LIGHT ADAPTATION, by A. Arduini and L. R. Pinneo. [1963] [15]p. (AFOSR-J1331) (AF 61(052)107) AD 424228; AD 632625
Unclassified

Also published in Arch. Ital. Biol., v. 101: 493-507, 1963.

Experiments conducted on cats in nembutal anesthesia, midpontine pretrigeminals, cerveau isole and intact-brain with chronically implanted electrodes, have shown that the activity of the lateral geniculate nucleus follows closely the changes of level of the retinal output, as described in a previous paper. When the retina is continuously and diffusely illuminated the overall activity of the lateral geniculate decreases following the decrease in the level of the retinal output. During reversible retinal black-out, the overall activity of the lateral geniculate of the anesthetized animal decreases dramatically, reaching the level of the noise measured in the dead animal. Part of the activity remains in non-anesthetized preparations. The results are discussed.

2078

Pisa U. Inst. of Physiology (Italy).

NEUROPHYSIOLOGICAL ANALYSIS OF THE

"MOBBING RESPONSE" IN THE CHAFFINCH (FRINGILLA COELEBS), by P. Strata. [1964] [7]p. incl. diagr. refs. (AFOSR-64-1833) (AF 61(052)107) AD 449965   Unclassified

Also published in Arch. Ital. Biol., v. 102: 22-28, 1964.

The behavior of two groups of chaffinches in response to an owl has been analyzed. In one group of animals, a cerebral hemisphere and the ipsilateral eye were ablated, while in the other group a cerebral hemisphere and the contralateral eye were destroyed. The first group did not exhibit the mobbing response, whereas the second group did. Both groups were able to distinguish between true and false seeds. Both groups showed normal mobility and the capacity to use the cells normally associated with mobbing response. It is concluded that the absence of a mobbing response in the first group of chaffinches is due specifically to the ablation of the cerebral hemisphere, and that the cerebral hemispheres are responsible for the elaboration of the visual messages which provoke to mobbing response. (Contractor's abstract)

2079

Pisa U. [Inst. of Physiology] (Italy).

THE PROBLEM OF A TRUE CONSENSUAL LIGHT REFLEX IN BIRDS, by G. Berlucchi and P. Strata. [1964] [7]p. (AFOSR-64-1834) (AF 61(052)107) AD 449966   Unclassified

Also published in Arch. Ital. Biol., v. 102: 29-35, 1964.

The problem of the consensual light reflex in birds was studied with the aid of two techniques which have recently been introduced into ocular physiology: examination under infrared light and photocoagulation of the optic papilla. The results obtained in the owl were: (1) In the normal owl the photic stimulation of one eye elicits a consensual pupillary constriction which is easily visible if the experiment is performed in the dark. (2) In the unilaterally blinded owl, photic stimulation of the normal eye elicits consensual pupillary constriction on the inactivated eye. (3) In the same experimental situation as in (2), the stimulation of the blind eye elicits a weak pupillo-constrictory response in the normal eye and a still weaker one in the blind eye. (4) After bilateral blinding it is no longer possible to elicit any iris response in either eye.

2080

Pisa U. [Inst. of Physiology] (Italy).

THE TONIC DISCHARGE OF THE RETINA AND ITS CENTRAL EFFECTS, by A. Arduini. [1963] [23]p. (AFOSR-64-2389) (AF 61(052)107) AD 452250   Unclassified

Also published in Prog. Brain Research, v. 1: 184-206, 1963.

This paper deals with the so-called spontaneous activity of the retina and discusses the results of a series of observations made from 1958 to 1961. Last year attention was transferred to the eye, and an attempt was made to relate the peripheral aspects of the retinal discharge to the results obtained at the level of the visual pathways and to the effects upon the EEG. The present studies have been concerned with fibre recordings from the optic chiasma with gross electrodes in collaboration with Dr. Pinneo, and from the retinal papilla with semimicroelectrodes in collaboration with Dr. Cavaggioni. This investigation is still under way. However, enough information is now available to present a rough picture of the behavior of the retina in dark adaptation and of the changes in the adaptation level brought about by steady illumination.

2081

Pisa U. Inst. of Physiology (Italy).

RESEARCH ON RELATIONS OF BRAIN STEM RETICULAR FORMATION TO ANIMAL BEHAVIOR, by G. Moruzzi. Final technical rept. June 15, 1962-Sept. 15, 1963, 13p. incl. refs. (AFOSR-J1323) (AF EOAR-62-9) AD 424838   Unclassified

The following themes have been the object of these investigations: (1) Intracellular recording from reticular neurons, (2) Dark discharge of retinal units, (3) Electrical activity of the lateral geniculate body during desynchronized sleep, (4) Neural mechanisms underlying visual accomodation, and (5) Behavioral investigations on the relationships between vision of polarized light and orientation in spiders. (Contractor's abstract, modified)

2082

Pisa U. Inst. of Physiology (Italy).

RESEARCH ON THE STRUCTURE AND PHYSIOLOGY OF THE EYES OF A LYCOSID SPIDER. II. THE ROLE OF DIFFERENT PAIRS OF EYES IN ASTRONOMICAL ORIENTATION, by F. Magni, F. Papi and others. [1964] [14]p. incl. illus. diagrs. refs. (AFOSR-64-1701) (AF EOAR-62-9) AD 448265   Unclassified

Also published in Arch. Ital. Biol., v. 102: 123-136, 1964.

The functional role of single pairs of eyes of the wolf-spider Arctosa variana C. L. Koch in astronomical orientation was studied. The visual fields above the horizon of individual eyes were determined by the method of Homann. The principal eyes alone are able to ensure a correct astronomical orientation, although less precise than that of normal animals. The orientation is strongly disturbed if secondary eyes alone are left uncovered; it becomes altogether erratic if one single pair of secondary eyes alone is left uncovered.

2083

Pisa U. [Inst. of Physiology] (Italy).

RETICULAR INFLUENCES ON THE EEG, by G. Moruzzi. [1964] [17]p. (AFOSR-64-1702) (AF EOAR-62-9) AD 448266   Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol., v. 16: 1-17, 1964.

This report is concerned exclusively with the influence of the brain-stem on spontaneous electro-cortical activity in two opposite conditions, wakefulness and sleep, and our main aim will be to relate behavior and EEG with the activity of different parts of the brain-stem. Experimental data are presented.

2084

Pisa U. [Inst. of Physiology] (Italy).

ACTIVE PROCESSES IN THE BRAIN STEM DURING SLEEP, by G. Moruzzi. [1963] [64]p. (AFOSR-64-1709) (AF EOAR-62-9) AD 448273   Unclassified

Also published in The Harvey Lectures, Series 58: 233-297, 1963.

The present report is centered around the deafferentation hypothesis of sleep, with particular regard to its historical development and to the challenge which arises from the observations made during the last five years, all pointing to an active participation of the brain stem in the process of falling asleep and in the maintenance of sleep.

2085

Pisa U. [Inst. of Physiology] (Italy).

SLOW PERIODICITY IN THE DARK DISCHARGE OF RETINAL UNITS, by D. Ascoli and L. Maffei. [1963] [2]p. (AFOSR-64-1710) (AF EOAR-62-9) AD 448264
                                        Unclassified

Also published in Experientia, v. 20: 226-227, 1964.

During experiments concerned with the statistical parameters of retinal discharge under conditions of complete dark adaptation, an almost regular periodic firing pattern was sometimes observed in retinal ganglion cells. In a number of experiments, the firing of the dark adapted cells was observed to fluctuate, disappearing and reappearing with a certain periodicity. The time course of these fluctuations was sometimes of a few seconds. Frequently, however, a surprisingly slow periodicity, of the order of a few and even of several minutes, was observed.

2086

Pisa U. [Inst. of Physiology] (Italy).

[PERIODIC ACTIVITY IN THE CAT RETINA]

Attivita' periodica nella retina del gatto, by D. Ascoli and L. Maffei. [1963] [2]p. (AFOSR-64-2153) (AF EOAR-62-9) AD 452328   Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 39: 1998-1999, Sept. 1963.

A rhythmic discharge has been observed in the retinal cells of dark-adapted cats during microelectrode recordings from the optic papilla or ganglion cells. In some cases this regular discharge demonstrates a rhythmic disappearance and reappearance with a periodicity of a few seconds; this periodicity has already been reported in the literature. At only a few points in the retina, however, the author observed a slower periodicity of the order of several minutes which has not been previously described.

2087

Pisa U. Inst. of Physiology (Italy).

THE PROPERTIES OF RETICULO-SPINAL NEURONS, by W. D. Willis and F. Magni. 1964, 11p. (AFOSR-65-2847) (AF EOAR-62-9) AD 629204   Unclassified

Also published in Prog. Brain Research, v. 12: 56-64, 1964.

Reticulo-spinal neurons are identified by intracellular recording of the antidromic action potentials resulting from stimulation of the spinal cord. The characteristics of their action potentials are described. The axons of reticulo-spinal cells are found to conduct at rates up to 130m/sec and to have relatively low thresholds for electrical stimulation. The axons project as far caudally as S1 and travel in the ventral part of the cord. Reticular neurons with axons projecting both caudally into the cord and rostrally to the midbrain are described. The functional role of the reticulo-spinal neurons studied is discussed.

2088

Pisa U. Inst. of Physiology (Italy).

AFFERENT CONNECTIONS TO RETICULO-SPINAL NEURONS, by F. Magni and W. D. Willis. [1964] [13]p. (AFOSR-65-2848) (AF EOAR-62-9) AD 629207
                                        Unclassified

Also published in Prog. Brain Research, v. 12: 246-258, 1964.

Reticulo-spinal neurons of the cat brain stem have been shown to receive excitatory connections from a wide area of the cerebral cortex. The strength of the connections varies both with the cortical area stimulated and with the particular neuron investigated. The effects of changing stimulus parameters are described. Examples are given of excitatory and inhibitory postsynaptic potentials evoked in reticulo-spinal neurons by stimulation of a pathway traversing the region of the central tegmental tract of the mesencephalon. The action of peripheral nerves of the forelimb upon reticulo-spinal neurons is shown in many cases to be complex.

2089

Pisa U. Inst. of Physiology (Italy).

SUBCORTICAL AND PERIPHERAL CONTROL OF
BRAIN STEM RETICULAR NEURONS, by F. Magni
and W. D. Willis. [1964] [15]p. (AFOSR-65-2849)
(AF EOAR-62-9) AD 629205   Unclassified

Also published in Arch. Ital. Biol., v. 102: 434-448,
1964.

Several types of neurons of the brain stem reticular
formation are shown to receive postsynaptic potentials
from stimulation in the region of the central tegmental
tract in the rostral mesencephalon. The transmission
of excitatory postsynaptic potentials is monosynaptic.
An incidental finding which is reported is the reversal
of sign of the after-potential immediately following the
spike potential in a reticulospinal neuron as the mem-
brane potential changes. The action of volleys in a cu-
taneous and a muscular nerve of the forelimb upon re-
ticulospinal neurons was studied. The effects appear
to be mediated chiefly by low threshold cutaneous fi-
bers and group II muscle afferent fibers. The interac-
tion of postsynaptic potentials from peripheral nerve
and cerebral cortical stimulation is described.

2090

Pisa U. Inst. of Physiology (Italy).

CORTICAL CONTROL OF BRAIN STEM RETICULAR
NEURONS, by F. Magni and W. D. Willis. 1964, 20p.
(AFOSR-65-2850) (AF EOAR-62-9) AD 629206
                                      Unclassified

Also published in Arch. Ital. Biol., v. 102: 18-33, 1964.

The effects of corticofugal volleys upon reticular neu-
rons were studied in anaesthetized and pyramidal cats.
Most reticulospinal neurons were excited by cortical
volleys, as were reticular neurons with axons project-
ing both rostrally and caudally. Reticular neurons
with long ascending axons were, however, only occa-
sionally affected. Inhibitory postsynaptic potentials
were seldom observed and then only following excita-
tory potentials. There was a widespread convergence
of excitatory action from many areas of the cerebral
cortex upon individual reticular neurons.

2091

Pisa U. Inst. of Physiology (Italy).

COMPARATIVE NEUROPHYSIOLOGY OF VISION, by
G. Moruzzi. Final technical rept. Sept. 15, 1964, 9p.
incl. refs. (AFOSR-65-0039) (AF EOAR-63-9)
AD 455012   Unclassified

The following themes have been the object of investiga-
tions: (1) Behavior of retinal units during dark adapta-
tion, (2) Study of biological noise in the retina, (3)
Transfer properties of the cat's eye, (4) Effect of
darkness on the onset of sleep in birds, (5) Electro-

retinography in Lycosa tarentula, (6) Intracellular re-
cording from reticular neurons, and (7) Relationships
between midline thalamic nuclei and reticular formation.
(Contractor's abstract, modified)

2092

Pittsburgh U. [Dept. of Biology] Pa.

FLASH SPECTROSCOPY AND FLASH FLUORIMETRY
IN PHOTOSYNTHETIC STUDIES, by J. L. Rosenberg.
Final rept. Feb. 1, 1962-Jan. 31, 1963. Apr. 1,
1963, 4p. (AFOSR-4703) (AF 49(638)762) AD 409594
                                      Unclassified

A comparative study of the flash induced formation of a
pigment, X, absorbing at 515 mμ in different classes of
algae was made. This material X, still unidentified,
had previously been observed principally in the green
algae. The X is formed during saturating flashes also
in the blue-green Anacystis nidulans and in the red
Porphyridium Cruentum. In Porphyridium, the ratio
of the maximum X formation to total chlorophyll was
observed to be only 10% of the value of this ratio in the
green alga Chlorella. Another measured difference is
that the rate constant for disappearance of X in the dark
following a flash is five times as great in Porphyridium
as in Chlorella.

2093

Pittsburgh U. Dept. of Chemistry, Pa.

SOME DEOXYGENATION REACTIONS OF AMINE
OXIDES, by T. Cohen. Final rept. Aug. 28, 1963, 15p.
incl. refs. (AFOSR-J1078) (AF 49(638)788) AD 419928
                                      Unclassified

This project involves a survey of the reactions of amine
oxides with various electrophilic compounds such as
anhydrides, esters, α, β-unsaturated carbonyl com-
pounds and epoxides. A new oxidation of epoxides by
amine oxides or dimethyl sulfoxide was discovered.
The reactions of pyridine-N-oxide with dimethyl ace-
tylenedicarboxylate and with naphthoquinone result in
self-reactions of the latter compounds. Pyridine-N-
oxide was found to form a 2:1 molecular complex, pre-
sumably of the charge-transfer variety with tetrahy-
droxydinaphthalene. The structure of the "hydrazone"
of dehydrodinaphthoquinone was reinvestigated. An un-
usual redox reaction occurred when N-acyloxypyridini-
um halides were pyrolyzed producing pyridine, the
carboxylic acid and halogenated organics. Other reac-
tions are discussed.

2094

Pittsburgh U. [Dept. of Chemistry] Pa.

SOME N-BUTYL AND PHENYL PHOSPHONIUM
SALTS, by G. Witschard and C. E. Griffin. [1964]
[1]p. (AFOSR-64-1489) (AF AFOSR-62-48) AD 446142
                                      Unclassified

Also published in Jour. Chem. and Eng. Data, v. 9: 255, Apr. 1964.

During the course of a study of the infrared spectra of phosphonium structures, a number of unreported n-butyl and phenyl phosphonium salts were prepared. These salts were obtained in acceptable yields by simple quaternization of the appropriate phosphine by an alkyl halide in refluxing benzene or in the absence of solvent. In two instances, the halides obtained from the reaction mixture could not be crystallized satisfactorily; conversion to the corresponding iodide led to the formation of crystalline material.

2095

Pittsburgh U. Dept. of Chemistry, Pa.

MAGNETIC CHARACTERISTICS OF LAVES PHASES CONTAINING LANTHANIDE METALS COMBINED WITH NICKEL, by E. A. Skrabek and W. E. Wallace. [1963] [2]p. incl. diagr. table, refs. (AFOSR-64-1513) (AF AFOSR-63-167) AD 446361   Unclassified

Also published in Jour. Appl. Phys., v. 34: 1356-1357, Apr. 1963.

Studies have been made of the series of compounds represented by the formula ANi_2, in which A is Y, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, and Lu. These compounds are all isostructural, possessing the $MgCu_2$ structure. Nine of the compounds exhibit magnetic ordering at temperatures ranging from 6°K (for $PrNi_2$) to 90°K (for $GdNi_2$). The Y, Ce, and Lu remain paramagnetic down to liquid helium temperatures. YNi_2 and $LuNi_2$ exhibit Pauli paramagnetism from 4° to 300°K suggesting that nickel has a filled 3d shell and is not carrying a moment in these phases. $CeNi_2$ likewise exhibits Pauli paramagnetism, which implies that Ce has been ionized to the quadripositive state. The measured saturation moment extrapolated to 0°K is in good agreement with the value expected if nickel is nonmagnetic and the lanthanide component carries the moment of the free tripositive ion in the case of $GdNi_2$ but is in poor agreement for the eight other compounds which order magnetically.

2096

Pittsburgh U. Dept. of Chemistry, Pa.

MAGNETIC PROPERTIES OF $GdFe_2$ AND $DyFe_2$, by M. Mansmann and W. E. Wallace. [1963] [2]p. incl. diagr. table. (AFOSR-64-1514) (AF AFOSR-63-167) AD 446359   Unclassified

Also published in Jour. Chem. Phys., v. 40: 1167-1168, Feb. 15, 1964.

Magnetization-temperature data were obtained over the range 4.2 to 825°K and saturation magnetizations were measured at 4.2, 77°K and room temperature (taken to be 300°K). The magnetization-temperature

behavior of $DyFe_2$ closely resembles that of $GdFe_2$ except at temperatures below 60°K. $DyFe_2$ is considerably harder magnetically than $GdFe_2$, and hence it is not clear as yet whether its reduced moment below 60°K is an intrinsic property or is merely due to magnetic hardness. For most of the temperature range the magnetization decreases almost linearly with temperature. This unusual temperature dependence and the magnitude of the observed moments strongly suggest that $DyFe_2$ and $GdFe_2$ are ferrimagnetic materials.

2097

Pittsburgh U. Dept. of Chemistry, Pa.

A THEORY OF LIGHT UTILIZATION IN PLANT PHOTOSYNTHESIS, by J. Franck and J. L. Rosenberg. [1964] [26]p. incl. refs. (AFOSR-3039) (AF AFOSR-63-349)   Unclassified

Also published in Jour. Theoret. Biol., v. 7: 276-301, 1964.

A model for the photochemical steps in photosynthesis is described in which only one type of reaction center participates in the chemical conversion of excitation energy. Two types of energy-collecting pigment systems can occur, but in distinction to most current models the energy is delivered to a unique type of chlorophyll-enzyme complex. Of the two photochemical steps in photosynthesis, one is mediated by the metastable triplet state of chlorophyll in this complex and the other requires singlet excitation for efficient operation. The nature of chlorophyll in the two pigment systems is identified on the basis of spectroscopic evidence. The far-red absorbing pigment, P700, is considered to be a crystallized chlorophyll that may participate in photosynthetic energy collection but is not essential for the overall process. The model is tested by comparisons with experimental evidence from fluorescence, afterglow, the Emerson effect, reversible bleaching, and alternate photochemical pathways. (Contractor's abstract)

2098

Pittsburgh U. [Dept. of Chemistry] Pa.

FLASH SPECTROSCOPY OF PORPHYRIDIUM, by E. Inselberg and J. L. Rosenberg. [1964] [3]p. (AFOSR-64-2269) (AF AFOSR-63-349) AD 452434
          Unclassified

Also published in Plant Physiology, v. 39: 810-612, Sept. 1964.

The objective of this study was to investigate flash-induced absorption changes in Porphyridium cruentum, especially the occurrence of the 515 mμ change.

2099

Pittsburgh U. Dept. of Chemistry, Pa.

DIFFERENTIAL REACTIVITY OF EXCITED SINGLETS
AND TRIPLETS, by J. L. Rosenberg. [1964] [4]p. incl.
refs. (AFOSR-65-2752) (AF AFOSR-63-349)
Unclassified

Also published in Photochem. and Photobiol., v. 3:
295-298, 1964.

Experimental data from the oxygen quenching of excited
states, from the acidities of excited states, and from
the kinetics of photosynthesis indicate that the lowest
excited singlet and the lowest triplet states of aromatic
molecules may not have the same reactivity. The
reasons for these differences may be connected with
the energy deficit of triplets, with spin conservation
rules, with differences in the nuclear geometry, or with
differences in the electronic configuration or polariza-
bility. With improved theoretical representations of
excited states, the observed differences in reactivity
may serve to increase our understanding of the nature
of primary photochemical events.

2100

Pittsburgh U. [Dept. of Pharmacology] Pa.

ATROPINE DETOXICATION DURING HYPOTHERMIA
BY THE ISOLATED PERFUSED RAT LIVER. Final
technical rept. Oct. 2, 1963, 10p. (AFOSR-J1058)
(AF AFOSR-63-87) AD 419701   Unclassified

Considerable information was gained on the metabolism
of C^{14} atropine by the isolated, perfused rat liver under
normothermic and hypothermic conditions. The half-
life of the drug is prolonged under hypothermic condi-
tions, and the per cent of drug remaining in the plas-
ma 4 hr after administration is greater at the low
temperatures. At all temperatures, the material ap-
pearing in the bile is an altered form of the drug and
none of the 5 chromatographically separable compounds
is tropic acid. Biliary secretion of atropine metabo-
lites by intact, nephrectomized rats shows good agree-
ment with similar data obtained from the isolated, per-
fused liver at 37°C and at 25°C.

2101

Pittsburgh U. [Dept. of Physics] Pa.

QUESTION OF SIZE CORRECTIONS TO THE STEADY
DIAMAGNETIC SUSCEPTIBILITY OF SMALL SYS-
TEMS, by L. Friedman. [1964] [9]p. (AFOSR-64-
1215) (AF AFOSR-63-196) AD 443021   Unclassified

Also published in Phys. Rev., v. 134: 336-344, Apr.
20, 1964.

The order of magnitude of the (orbital) diamagnetic
susceptibility of a free-electron gas is investigated
for the case of "small" systems. A small system is,
by definition, one whose characteristic linear dimen-
sions are very much less than the radii of the average
classical electronic orbits in an applied dc magnetic
field. For the case of plane-slab geometry, exactly
the Landau susceptibility (i.e., no size effect) is ob-
tained for Maxwell-Boltzmann statistics. Furthermore,
on the basis of the latter calculation, it is explicitly
demonstrated that the use of the WKB approximation
leads to a spurious size effect, suggesting that this (or
equivalent) approximations may be responsible for
size corrections found by other authors. For the de-
generate case, the Landau result is also obtained, to
within a numerical factor.

2102

Pittsburgh U. [Dept. of Physics] Pa.

EFFECT OF NONUNIFORM MAGNETIZATION ON THE
SPINWAVE SPECTRUM IN THIN FERROMAGNETIC
FILMS, by J. T. Davies. [1964] [2]p. (AFOSR-64-
1216) (AF AFOSR-63-196) AD 443022   Unclassified

Also published in Jour. Appl. Phys., v. 35: 804-805,
Mar. 1964.

It was first suggested by Portis that the linear posi-
tioning of the first few spin-wave modes observed in
some ferromagnetic films could be due to a nonuniform
static magnetization M, and he examined a simple
model which showed this effect. This model, where the
magnetization falls parabolically from the film center,
has been studied in greater detail. The modes found by
Portis are incorrect in detail, since they all collapse
onto the uniform mode as the distortion of M goes to
zero. A more suitable choice of boundary conditions
gives rise to a spectrum where the lower modes are
linearly positioned whereas the higher modes tend to
the more usual quadratic positioning. For a given rela-
tive distortion, the number of linear modes should be
greater the thicker the film.

2103

Pittsburgh U. [Dept. of Physics] Pa.

DENSITY MATRIX FORMULATION OF SMALL-
POLARON MOTION, by L. Friedman. [1964] [14]p.
(AFOSR-64-2115) (AF AFOSR-63-196) AD 451577
Unclassified

Also published in Phys. Rev., v. 135: A233-A246,
July 6, 1964.

A density-matrix treatment of small-polaron motion is
presented for the case in which the electronic overlap
term of the total Hamiltonian is a small perturbation.
The principal result of the density matrix formalism is
that total small-polaron mobility can be expressed as
the sum of a band part, characteristic of the low-tem-
perature regime, plus a part describing the hopping
motion dominant at high temperatures. This verifies
the separation of the above two types of motion made on
the basis of physical arguments.

2104

Pittsburgh U. [De ... of Physics] Pa.

A STUDY OF ELECTRICAL AND THERMAL RESIST-
IVITIES OF Fe, Co AND Ni USING A TWO-BAND
MODEL, by L. Colquitt and D. A. Goodings. [1965]
[3]p. incl. diagrs. refs. (AFOSR-65-0807)
(AF AFOSR-63-196) AD 618004   Unclassified

Also published in Proc. Internat'l. Conf. on Magnetism,
Nottingham (Gt. Brit.), Sept. 1963, p. 29-31.

A description is given of recent calculations of the con-
tributions to the electrical resistivity ρ and the thermal
resistivity W of Fe, Co and Ni due to "spin disorder"
scattering, i.e. the scattering of conduction electrons
by spin waves occurring through the s-d exchange in-
teraction. The single-band theory of Kasuya and
others has been extended to a model consisting of 2
spherical energy bands, representing the 4s-4p conduc-
tion band and the itinerant d electrons in these metals.
At the lowest temperatures the electrons are mainly
scattered within each band, but at higher temperatures
scattering involving s-d transitions becomes important
and gives contributions to ρ and W about an order of
magnitude larger than the single-band contributions.
(Contractor's abstract)

2105

Plasmadyne Corp., Santa Ana, Calif.

A FUNDAMENTAL THEORETICAL AND EXPERI-
MENTAL STUDY OF ROTARY MAGNETOHYDRODY-
NAMICS, by V. A. Erma and B. Podolsky. Final rept.
Jan. 21, 1964, 88p. incl. illus. diagrs. refs. (Rept.
no. FR113-1149) (AFOSR-64-2475) (AF 49(638)1149)
AD 609812   Unclassified

A combined theoretical and experimental investigation
of the magnetohydrodynamics of a magnetically driven
vortex, including both a closed cycle (homopolar) and
open cycle (helical) configuration, constructed in this
laboratory, was made. The theory of the magnetohy-
drodynamics of the homopolar device for the general
case of an incompressible conducting fluid is presented,
and the resulting system of equations simplified appre-
ciably. Detailed discussions of the two special cases
of very high and very low conductivity are given. The
cases of a homopolar device with a compressible fluid,
and a helical device with an incompressible fluid are
likewise discussed in a preliminary manner. A de-
tailed experimental study of the homopolar device, in-
cluding exhaustive measurements of the static pres-
sure, azimuthal and radial velocities, boundary layer
behavior, and the effect of a changing electrode radius
was made. The experimental work concerned with the
helical device was preliminary, and was limited to
measurements of the net outflow velocity.

2106

Politecnico di Torino. Laboratorio de Meccanica
Applicata (Italy).

ANALYSIS OF SOME EXPERIMENTAL RESULTS

ON THE DISSOCIATION OF DIATOMIC GASES IN THE
SHOCK TUBE, by G. Jarre. Jan. 1963, 20p. (Tech-
nical note no. 23) (AFOSR-4857) (AF 61(052)511)
AD 631563   Unclassified

The experimental results, given by recent shock tube
techniques, on the dissociation of diatomic gases are
analyzed. A characteristic frequency of association is
derived, which allows one to correlate suitably the ex-
periments on different gases. An elementary thermo-
dynamic derivation of the chemical rate constants is
presented.

2107

Politecnico di Torino. Laboratorio di Meccanica
Applicata (Italy).

EXPERIMENTAL RESEARCH WITH A SHOCK TUBE OF
THE "CENTRO STUDI SULLA DINAMICA DEI FLUIDI",
by A. Romiti. June 1964, 13p. incl. illus. diagrs.
refs. (Scientific rept. no. 1; technical note no. 25)
(AFOSR-64-1876) (AF EOAR-63-98) AD 449981
                              Unclassified

Shock speed, wall temperature, heat flux, and pressure
measurements are given. Particularly emphasized is
the description of some original results on the behavior
of a metallic probe in a stream of high temperature,
partially ionized gas.

2108

Polytechnic Inst. of Brooklyn. Dept. of Aerospace
Engineering and Applied Mechanics, N. Y.

AN EXPERIMENTAL INVESTIGATION OF THE TURBU-
LENT MIXING ON NON-HOMOGENEOUS COAXIAL
JETS, by L. J. Alpinieri. Aug. 1963, 64p. incl. diagrs.
(PIBAL-789) (AFOSR-5242) (AF 49(638)217)
AD 421741   Unclassified

Experimental results on the turbulent mixing process
between carbon dioxide and hydrogen central jets ex-
hausting into a moving concentric stream of air are pre-
sented. The diffusion of mass and momentum only are
considered, since both streams are at approximately
equal temperature. Principal points of investigation
are the condition of equal velocity between jets and the
condition of equal mass flow per unit area between jets.
Radial and axial distributions of concentration and ve-
locity are presented. On the basis of the measure-
ments it is concluded that no tendency towards segrega-
tion of the stream exists when either the velocities
or the mass flows of the streams are equal. Further-
more, it is demonstrated that the product of local den-
sity and eddy kinematic viscosity coefficient can be as-
sumed to be solely dependent upon the axial coordinate.

2109

Polytechnic Inst. of Brooklyn. Dept. of Aerospace
Engineering and Applied Mechanics, N. Y.

A REVIEW OF THE WORK PERFORMED AT THE

POLYTECHNIC INSTITUTE OF BROOKLYN AERO-
SPACE INSTITUTE UNDER CONTRACT AF 49(638)217,
by A. Ferri and R. Vaglio-Laurin. Sept. 1, 1957-Aug.
31, 1963. Sept. 1963, 3'p. incl. refs. (PIBAL-609)
(AFOSR-5426) (AF 49(636)217) AD 621162
Unclassified

A summary is given of theoretical and experimental
investigations on fundamental aspects of inviscid and
viscous flow problems in the supersonic and hypersonic
speed regimes.

2110

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace
Engineering and Applied Mechanics] N. Y.

EXTERNAL HYPERSONIC FLOWS, by A. Ferri and R.
Vaglio-Laurin. [1963] [9]p. incl. refs. (AFOSR-
J436) (AF 49(638)217) AD 407697   Unclassified

Also published in Aerospace Eng., v. 22: 23-31, Jan.
1963.

An account is presented of solved and unsolved questions
bearing on the analysis of flows about practical hyper-
sonic vehicles. Fluid-mechanical aspects and features
of the problem are considered first; methods of ana-
lysis for two-dimensional and general three-dimen-
sional configurations in continuum inviscid flows, as
well as recent investigations of aerodynamic charac-
teristics in the rarified flow regime, are reviewed.
Physicochemical aspects of the problem are consid-
ered next; required extensions of the aforementioned
methods to include effects of chemical reactions and
radiation, as well as current capabilities for determin-
ing and correlating observables in complete flow pat-
terns, are discussed. Finally, recent investigations
of trails left behind vehicles upon re-entry into the at-
mosphere are considered. Unsolved questions and
topics for future research in each problem area are
indicated.

2111

Polytechnic Inst. of Brooklyn. Dept. of Aerospace
Engineering and Applied Mechanics, N. Y.

TURBULENT MIXING OF COAXIAL JETS, by J. L.
Alpinieri. [1964] [8]p. incl. diagrs. table. refs.
(AFOSR-64-2232) (AF 49(638)217) AD 452342
Unclassified

Also published in AIAA Jour., v. 2: 1560-1567, Sept.
1964.

Experimental results on the turbulent mixing process
between carbon dioxide and hydrogen central jets ex-
hausting into a moving concentric stream of air are
presented. The diffusion of mass and momentum only
are considered, since both streams are at approxi-
mately equal temperature. The flow velocities are
in the low to high subsonic range. Principal points of
investigation are the condition of equal velocity be-
tween jets and the conditions of equal mass flow per
unit area between jets. Radial and axial distributions

of concentration and velocity are presented. On the
basis of the measurements, it is demonstrated that the
product of local density and eddy kinematic viscosity
coefficient can be assumed to be solely dependent upon
the axial coordinate. Furthermore, it is concluded that
no tendency toward segregation of the streams exist
when either the velocities or the mass flows of the
streams are equal. In agreement with previous results,
it is found that mass appears to diffuse more readily
than momentum.

2112

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace
Engineering and Applied Mechanics] N. Y.

SOME PERTURBATION SOLUTIONS IN LAMINAR
BOUNDARY LAYER THEORY. PART 2. THE ENERGY
EQUATION, by H. Fox and P. A. Libby. [1964] [19]p.
(AFOSR-64-1677) (AF 49(638)217) AD 449982
Unclassified

Also published in Jour. Fluid Mech., v. 19: 433-451,
1964.

Solutions for two types of problems involving the energy
equation for flows with velocities described by the
Blasius solution are presented. The first type arises
in flows with arbitrary initial distributions of stagna-
tion enthalpy and with surfaces downstream of the ini-
tial station either with constant wall enthalpy or with
zero heat transfer. Exact solutions in these cases are
obtained for constant $\rho\mu$ and Prandtl number of unity;
they are given in terms of complete orthogonal sets of
functions which can be used to obtain first- and higher-
order corrections for the effects of variable $\rho\mu$, non-
unity Prandtl number, and deviations of the velocity
field from that described by the Blasius solution. The
second type of problem pertains to flows with power-
law descriptions of the wall enthalpy.

2113

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace
Engineering and Applied Mechanics] N. Y.

A FURTHER NOTE ON THE CREEP ANALYSIS OF
ANNULAR PLATES, by B. Venkatraman, S. A. Patel,
and M. R. Birnbaum. May 1964, 13p. incl. diagrs.
(PIBAL-695) (AFOSR-64-1039) (AF 49(636)1360)
AD 604467   Unclassified

Also published in Jour. Franklin Inst., v. 276: 246-
255, Oct. 1964.

On the basis of a creep law formulated in terms of the
Tresca criterion, the creep bending of annular plates
were analyzed by Venkatraman and Patel. The present
note considers the solutions presented there for plates
with sufficiently small holes and sufficiently large
holes and quantitatively defines the transition from one
solution to the other. The note concludes with the com-
plete solution to the problem of an annular plate with its
inner edge free and outer edge clamped and under uni-
form lateral pressure. (Contractor's abstract)

2114

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

LARGE DEFLECTIONS OF AN AXIALLY COM-PRESSED OVAL CYLINDRICAL SHELL, by J. Kempner and Y. N. Chen. [1964] [7]p. incl. diagrs. table. (AFOSR-67-2067) (AF 49(638)1360)
Unclassified

Also published in Proc. Eleventh Internat'l. Conf. Applied Mechanics, Munich (Germany), 1964, p. 299-305.

In the present investigation the principle of minimum potential energy is applied to the nonlinear analysis of a family of oval cylinders whose cross sections are characterized by a simplified form of an expression for the curvature proposed by Marguerre. The present approximate solution is analogous to that commonly applied in energy analyses of the circular cylinder, except that the total potential energy is no longer considered as a continuous function of a circumferential wave-length parameter. The selection of the radial deflection function is based upon those functions previously considered for the circular cylinder, as well as upon the Fourier series solution employed in the classical buckling problem of the oval cylinder.

2115

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

INVESTIGATION OF PLATES AND SHELLS UNDER EXTERNAL LOADING AND ELEVATED TEMPERA-TURES, by J. Kempner. Final rept. Apr. 1963, 14p. (PIBAL-664) (AFOSR-4706) (AF AFOSR-62-200) AD 407886   Unclassified

The studies briefly described stem from continuing investigations of plates and shells under external load-ing and elevated temperatures, and include problems of special interest to designers of missiles and air-craft. Chapter I presents the results of investigations of the effects of creep in structures, with particular emphasis on the bending of circular plates. Chapter II outlines the work performed on heat conduction prob-lems using Biot's variational method. Chapter III discusses the problem of the buckling and postbuckling of noncircular cylindrical shells under axial compres-sion. Chapter IV describes work on the analysis of the effects of concentrated loads applied to reinforcing frames of finite and infinitely long circular cylindrical shells. Chapter V discusses the results obtained from the analysis of the dynamic response of plastic spheri-cal shells.

2116

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

CREEP OF COMPRESSIBLE CIRCULAR PLATES,

by S. A. Patel, F. A. Cozzarelli, and B. Venkatraman. [1963] [9]p. incl. diagrs. tables. (AFOSR-J230) (AF AFOSR-62-200) AD 400685   Unclassified

Also published in Internat'l. Jour. Mech. Sci., v. 5: 77-85, 1963.

The present paper is concerned with the creep bending analysis of compressible circular plates. The analysis stems from a non-linear creep law formulated on the basis of an assumed complementary energy function for an analogous elastic material. The method of analysis is one of iteration and is applicable in general to such plates subjected to radially symmetric loads. Solutions for moments and deflexions are obtained for simply supported and clamped edge circular plates under uni-formly distributed loads. (Contractor's abstract)

2117

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

LAMINAR BOUNDARY LAYERS WITH CHEMICAL REACTIONS, by H. Fox. June 1964, 56p incl. diagrs. tables, refs. (PIBAL-835) (AFOSR-64-1394) (AF AFOSR-62-200) AD 605321   Unclassified

A complete discussion is presented of the chemically reacting laminar boundary layer. Included in the study are separate homogeneous and hetergeneous reactions; additionally there is considered the problem of simul-taneous gas phase and wall reaction. The basic solu-tion, under conditions of unit transport properties, i.e., mass density-viscosity product constant, Prandtl number and Schmidt unity were derived using previous devised operator techniques. For gas phase reaction the solution for the species distribution is seen to re-duce to an integral equation; the temperature arising by quadrature. It is shown that simple first order re-sults for chemistry of the usual complexity occurring in hypersonic boundary layer flows can be obtained with-out resort to large scale computation. The flow over a catalytic wall is derived from unit solutions to the basic problem.

2118

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

EIGENVALUES FOR THE EQUATION OF SPECIES CONSERVATION WITH HETEROGENEOUS REACTION, by G. S. Janowitz and P. A. Libby. [1964] [2]p. incl. diagr. table. (AFOSR-65-0031) (AF AFOSR-62-409) AD 611615   Unclassified

Also published in AIAA Jour., v. 2: 1849-1850, 1964.

In a prior paper, two initial value problems are pre-sented involving the energy equation for laminar bound-ary layers with velocity fields described by the Blasius function. Two boundary conditions exist; in the one the wall enthalpy is constant and in the other the heat transfer is zero. The solutions for the energy distri-bution given can be applied to certain related problems

involving species and/or element conservation. The purpose of this note is to outline an extension of the considerations of the former paper with no gas phase reaction but with surface catalyticity in the downstream region. A number of related eigenvalues are given.

2119

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

OPTIMUM LAUNCHING OF A SATELLITE BY TWO IMPULSES OF UNEQUAL SPECIFIC IMPULSE, by L. Ting and M. Pierucci. [1963] [10]p. incl. diagrs. (AFOSR-4824) (AF AFOSR-63-1) AD 450007
Unclassified

Also published in Astronaut. Acta, v. 9: 174-183, 1963.

The problem of launching a satellite from a planet by two impulses of unequal specific impulse is investigated. When the ratio, λ, of the specific impulse of the first impulse to that of the second is less than $1/\beta$, the ratio of the radius of the planet to the radial distance of the perigee of the final orbit, i.e., $\lambda < 1/\beta$, the optimum launching orbit starts on the surface of the planet at an angle $\varphi_1 = \arc \cos(\lambda\beta)$, and ends at its apogee, which coincides with the perigee of the final orbit. When $\lambda \geq 1/\beta$, the optimum launching orbit is of the Hohmann type; i.e., it starts at its perigee and ends at its apogee. The latter coincides with the perigee of the final orbit for $\bar{\lambda} > \lambda > 1/\beta$ and with the apogee for $\infty > \lambda > \bar{\lambda}$ where $\bar{\lambda}$, lying between 1 and $1/\beta$, is a given function of β and α, where α is the ratio of the apogee distance of final orbit to the radius of the planet.

2120

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

LAMINAR, TRANSITIONAL, AND TURBULENT HEAT TRANSFER AFTER A SHARP CONVEX CORNER, by V. Zakkay, K. Toba, and T.-J. Kuo. [1964] [7]p. incl. diagrs. refs. (AFOSR-5318) (AF AFOSR-63-1)
Unclassified

Also published in AIAA Jour., v. 2: 1389-1395, Aug. 1964.

A flow model has been previously developed for treating the boundary-layer characteristics downstream of a surface discontinuity. The flow field in the neighborhood of the discontinuity or a sharp corner is divided into three regions: the flow upstream of the discontinuity which is obtained by standard techniques, that immediately downstream which is obtained by expanding both the supersonic and subsonic flow fields upstream of the discontinuity inviscidly around the corner, and that downstream of the discontinuity. The flow in the last region is represented by a viscous nonsimilar sublayer that starts at the discontinuity and by a viscous shear layer that has the profiles immediately downstream of the discontinuity as initial conditions. Based upon this flow model, analysis has been

developed using the inner and outer expansion techniques. It is the purpose of this report to improve on the treatment of the laminar analysis and to extend the technique of application of this model to include turbulent and transitional flow downstream of the corner. (Contractor's abstract)

2121

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

AXIALLY SYMMETRIC HETEROGENEOUS MIXING, by A. Ferri. Sept. 1963, 34p. (PIBAL-787) (AFOSR-5326) (AF AFOSR-63-1) AD 422973   Unclassified

Heterogeneous mixing is considered. Numerical methods are used to investigate the importance of simplifying assumptions usually introduced in the analysis of laminar mixing. Experiments on turbulent mixing are analyzed in order to obtain information on turbulent transport properties.

2122

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

APPROXIMATE ANALYTIC SOLUTIONS FOR THE RANGE OF A NONLIFTING RE-ENTRY TRAJECTORY, by T. R. Kornreich. [1963] [2]p. incl. table. (AFOSR-J1226) (AF AFOSR-63-1) AD 424299   Unclassified

Also published in AIAA Jour., v. 1: 1925-1926, Aug. 1963.

Presented is the development of approximate analytic solutions for the evaluation of the range of re-entry trajectories. An investigation was carried out to establish a simple criterion for the determination of whether a given supercircular re-entry trajectory is of the skip or direct impact type.

2123

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

GENERAL ASYMPTOTIC SUCTION SOLUTION OF THE LAMINAR COMPRESSIBLE BOUNDARY LAYER WITH HEAT TRANSFER, by M. Morduchow. [1963] [3]p. (AFOSR-J1227) (AF AFOSR-63-1) AD 424298
Unclassified

Also published in AIAA Jour., v. 1: 1949-1951, Aug. 1963.

For very large suction velocities at the wall, the asymptotic solution of the steady compressible two-dimensional laminar boundary layer over a surface of negligible curvature is derived under the following general conditions: an arbitrary prescribed axial pressure gradient, variable suction velocity, an arbitrary prescribed variable wall temperature, variable density, an arbitrary Mach number, a constant but arbitrary

Prandtl number, and constant specific heats but varia-
ble coefficients of viscosity and, hence, of heat conduc-
tivity. It is shown that the dimensionless asymptotic
velocity and temperature profiles remain the same re-
gardless of the pressure gradient and of the variability
of both the suction velocity and the wall temperature.
A Reynolds analogy for this solution is demonstrated.
Finally, comparison of the asymptotic solution is made
with recent numerical similarity solutions. (Contrac-
tor's abstract)

2124

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace
Engineering and Applied Mechanics] N. Y.

INTEGRAL METHOD SOLUTIONS OF LAMINAR VIS-
COUS FREE-MIXING, by M. H. Steiger and M. H.
Bloom. [1963] [3]p. incl. diagrs. tables. (AFOSR-
J1228) (AF AFOSR-63-1) AD 424310   Unclassified

Also published in AIAA Jour., v. 1: 1672-1674, July
1963.

This paper deals with laminar, two-dimensional, sym-
metric and axisymmetric, incompressible, uniform
pressure wakes and jets. Solutions are derived by us-
ing the simple one-strip integral method and are pre-
sented in closed form. It is shown that the present
theory agrees reasonably well with other more accu-
rate, but very cumbersome, methods of solution.
Compressibility, turbulence, thermal, and other dif-
fusive properties can be studied by analogous means.

2125

Polytechnic Inst. of Brooklyn. Dept. of Aerospace
Engineering and Applied Mechanics, N. Y.

VORTICITY EFFECT ON HEAT TRANSFER TO THE
CONICAL PORTION OF A BLUNT BODY, by L. Ting.
Sept. 1963, 21p. incl. diagrs. refs. (PIBAL-797)
(AFOSR-J1457) (AF AFOSR-63-1) AD 426427
Unclassified

Due to the fact that, associated with the vortical layer,
there is a steep density gradient with density decreas-
ing rapidly toward the wall, and that in the matching
region the density is very low, it is permissible to
neglect the product of density and gradient of first or-
der normal velocity as compared with the product of the
first order normal velocity and density gradient. With
this approximation it is then possible to deduce proper
matching conditions for the next order inner solution
from the governing equations of next order outer solu-
tion without actually solving them. With these proper
matching conditions, the differential equations for the
next order inner solutions are solved. Numerical
results on velocity profiles and enthalpy profiles are
presented. The effects of vorticity on heat transfer and
friction coefficients are obtained as functions of the
outer stream Mach number and the ratio of outer stream
enthalpy to wall enthalpy.

2126

Polytechnic Inst. of Brooklyn. Dept. of Aerospace
Engineering and Applied Mechanics, N. Y.

OPTIMUM LAUNCHING TO HYPERBOLIC ORBIT BY
TWO IMPULSES OF UNEQUAL SPECIFIC IMPULSE, by
S. Lubard. Jan. 1964, 29p. incl. diagrs. (PIBAL-
824) (AFOSR-64-0742) (AF AFOSR-63-1) AD 600963
Unclassified

Also published in Astronaut. Acta, v. 10: 138-151, 1964.

In this analysis the optimum launching of a body into a
non-intersecting hyperbolic orbit by two impulses is
presented. The effects of planet rotation and atmos-
pheric drag were not included. The conclusions of this
analysis can also be applied to the optimum landing on
a planet from a hyperbolic orbit. Only the planar case
was investigated, since this is always more economical
than the non-planar case. This problem can be defined
in terms of three-dimensionless parameters. It was
found convenient to use λ, a and b, where λ is the ratio
of the specific impulse of the first impulse to that of the
second, and a and b are the ratios of the radius of the
planet to the focal distance to the asymptote and to the
perigee of the hyperbolic orbit respectively.

2127

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace
Engineering and Applied Mechanics] N. Y.

SKIP-IMPACT CRITERIA OF A RE-ENTRY TRA-
JECTORY WITH NEGATIVE LIFT, by C. J. Ruger.
[1964] [3]p. incl. table. (AFOSR-64-1025) (AF AFOSR-
63-1) AD 440978   Unclassified

Also published in AIAA Jour., v. 2: 585-587, Mar.
1964.

For nonlifting re-entry trajectories it is known that if a
nonlifting body re-enters the atmosphere with subcir-
cular re-entry velocity the trajectory will be of the di-
rect-impact type, whereas for a supercircular re-
entry velocity the trajectory will be either a skip- or
direct-impact type, depending on the values of the re-
entry angle and velocity. This note presents an approx-
imate method for determining the critical re-entry an-
gle at which a trajectory switches from a skip- to a di-
rect- impact type when given a re-entry velocity and a
constant negative lift coefficient.

2128

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace
Engineering and Applied Mechanics] N. Y.

EFFECT OF SHOCK-INDUCED VORTICITY ON THE
COMPRESSIBLE BOUNDARY LAYER ALONG A FLAT
PLATE, by L. Ting. [1964] [4]p. incl. diagrs. refs.
(AFOSR-64-1026) (AF AFOSR-63-1) AD 440979
Unclassified

Also published in AIAA Jour., v. 2: 490-493, Mar.
1964.

Along the conical surface or the flat surface of a blunt-nosed body in high-speed flight there exists a vortical layer induced by the curved shock. It is the purpose of this paper to study the effect of the vortical layer on the boundary layer by the systematic procedure of matching the solution of the inner boundary layer to that of the outer layer.

2129

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

THE LAMINAR BOUNDARY LAYER WITH UNIFORM INJECTION, by P. A. Libby and K. Chen. June 1964, 8p. (PIBAL-836) (AFOSR-64-1395) (AF AFOSR-63-1) AD 606074   Unclassified

The non-similar velocity distribution in a two-dimensional laminar boundary layer with uniform external stream and with either uniform suction or injection is obtained by a series expansion in terms of a mass transfer parameter. The results are compared with more accurate analyses and shown to be in good agreement for a range of values of this parameter. The solution for the velocity distribution is then employed for the calculation of the distributions of energy and element mass fraction when there are imposed requirements for energy and mass balance at the exposed surface of a porous plate with uniform injection. As one example of several possible applications of these solutions, there is computed the flow associated with the injection of hydrogen into an airstream according to the flame sheet model.

2130

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

LINEARIZED ANALYSIS OF UNSTEADY, REACTING FLOWS WITH BODY FORCES, by P. M. Sforza. Sept. 1964, 19p. incl. diagrs. (PIBAL-848) (AFOSR-64-1673) (AF AFOSR-63-1) AD 609574
                                        Unclassified

An investigation of the effect of body forces on a one-dimensional, unsteady flow of a reacting gas is presented. The model proposed for this study is that employed by Sforza and Bloom i. e. a central region of gas is perturbed from the state and flow reference values of the ambient and the subsequent temporal and spatial variations of the imposed perturbations are studied analytically. In the present report the configuration of the perturbed region is taken to be slablike; this corresponds to a steady two-dimensional jet-or-wave-like flow. Results indicate that the effect of buoyancy forces on the velocity field is inversely proportional to the amount of energy absorbed in the chemical relaxation process. In particular, solutions for the case of very small chemical energy absorption become unbounded with time within the present approximation. (Contractor's abstract)

2131

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

SIMILARITY IN AXISYMMETRIC VISCOUS FREE MIXING WITH STREAMWISE PRESSURE GRADIENT, by M. H. Steiger. [1964] [1]p. (AFOSR-65-0918) (AF AFOSR-63-1) AD 617235   Unclassified

Also published in AIAA Jour., v. 2: 1509, Aug. 1964.

An earlier paper presented a nonlinear similarity equation for axisymmetric free-mixing with pressure gradients. In this note a brief derivation is presented of the axisymmetric similarity equation in more general form, and a particular solution is presented which may be expressed in closed form.

2132

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

ON THE COMPRESSIBLE LAMINAR BOUNDARY LAYER WITH SUCTION, by M. Morduchow and S. P. Reyle. Oct. 1963, 67p. (PIBAL-607) (AF AFOSR-63-1) AD 436886   Unclassified

The compressible laminar boundary layer in a pressure gradient with suction, for a Prandtl number of unity and a linear viscosity-temperature relation, is analyzed on the basis of the momentum and thermal integral equations in conjunction with sixth and (for separation) seventh degree velocity, and seventh degree stagnation enthalpy profiles. For flows over a flat plate, and for flows in a pressure gradient, straight-forward and simple methods of calculating the boundary layer for a given Mach number, a given uniform wall temperature, and a given suction distribution are shown.

2133

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

A STUDY OF THE IMPULSIVE MOTION OF A SEMI-INFINITE FLAT PLATE USING A LINEAR MODEL OF THE UNSTEADY BOUNDARY LAYER EQUATIONS, by R. C. Ackerberg. Dec. 1963, 23p. (PIBAL-621) (AF AFOSR-63-1) AD 602667   Unclassified

The impulsive motion of a semi-infinite flat plate in a fluid initially at rest is studied using a linear model of the unsteady boundary layer equations (introduced by Stewartson) and conventional Fourier and Laplace transform techniques. By imposing the physical condition that the skin friction be integrable at the leading edge, a unique solution is found which agrees with that obtained by Stewartson using a different method. All transforms are inverted in a formal way using a theorem on Laplace transforms due to Van der Pol, and the non-unique solutions are discussed.

2134

Polytechnic Inst. of Brooklyn. Dept. of Aerospace
Engineering and Applied Mechanics, N. Y.

CREEP DEFORMATIONS IN MEMBRANE SHELLS, by
F. A. Cozzarelli and S. A. Patel. [1964] [16]p. incl.
diagrs. (AFOSR-64-2246) (AF AFOSR-63-419)
Unclassified

Also published in Jour. Franklin Inst., v. 277: 45-60,
July 1964.

Creep deflections in membrane shells are analyzed in
this report. Governing equations are developed in de-
tail for shells with one infinitely large radius of curva-
ture, and for circumferentially closed shells of revo-
lution. For illustration, solutions are obtained for a
circular cone under wind load; a cycloidal vault under
uniform dead load; and a hemispherical cap under wind
load. (Contractor's abstract)

2135

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace
Engineering and Applied Mechanics] N. Y.

CREEP OF ANNULAR PLATES UNDER SYMMETRICAL
LATERAL PRESSURE, by S. A. Patel. [1964] [5]p.
incl. tables. (AFOSR-65-0921) (AF AFOSR-63-419)
AD 419425   Unclassified

Also published in Proc. Conf. on Thermal Loading and
Creep, Westminster (Gt. Brit.) 1964.

This paper investigates the creep bending of annular
plates subjected to radially symmetric loads. The
analysis is based on a non-linear creep law formu-
lated in terms similar to those used in plasticity
theory. The method of solution involves an iterative
procedure applicable, in general, to such problems.
The solutions for moments and deflections are given
for some particular examples.

2136

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical
Engineering] N. Y.

SHOCK-WAVE PROPAGATION IN LIQUID PROPEL-
LANT ROCKET ENGINES, by W. Chinitz and V. D.
Agosta. [1964] [19]p. incl. diagrs. refs. (AFOSR-
65-0565) (AF 49(638)165) AD 614201   Unclassified

Also published in Pyrodynamics, v. 1: 299-317, 1964.

A model is presented for longitudinal shock-wave propa-
gation in liquid propellant rocket engines. The equa-
tions, which include the effects of gaseous dissociation,
contain appropriate terms to account for the drag,
possible shattering, evaporation, and subsequent com-
bustion of the liquid fuel drops. The equations are
solved numerically on a digital computer. A compari-
son of the results obtained with previous experimental
work performed in a shock tube indicates good agree-
ment for shock-wave pressure ratios above about 3.5.

2137

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical
Engineering] N. Y.

LONGITUDINAL WAVE PROPAGATION IN LIQUID
PROPELLANT ROCKET MOTORS, by S. S. Hammer
and V. D. Agosta. [1964] [3]p. incl. diagr. (AFOSR-
65-0573) (AF 49(638)1263) AD 615187   Unclassified

Also published in AIAA Jour., v. 2: 2042-2044, Nov.
1964.

Longitudinal wave propagation studies are being con-
ducted in a liquid propellant rocket motor in order to de-
fine the parameters that determine whether an input dis-
turbance will attenuate or amplify. This has an im-
portant relation to combustion instability. Some recent
experimental data on wave-shape behavior in a liquid
rocket motor and measurements of the effect of Mach
number on the frequency of wave propagation are pre-
sented.

2138

Polytechnic Inst. of Brooklyn. Dept. of Mechanical
Engineering, N. Y.

ON LINEAR EQUATIONS OF ISOTROPIC ELASTIC
PLATES AND SHELLS, by Y.-Y. Yu. Feb. 1964, 34p.
(Scientific rept. no. 2) (AFOSR-64-2088) (AF 49(638)-
1290) AD 610139   Unclassified

Also published in Jour. Franklin Inst., v. 280: 395-
416, Nov. 1965.

A generalized Hamilton's principle and the associated
variational equation of motion for nonlinear elasticity
theory were given in a previous paper. Presented in
this paper is a modified linearized version, from which
the corresponding variational principle for an isotropic
shell of arbitrary thickness is deduced by means of the
series expansion method. The complete system of
shell equations are obtained as the Euler equations.
These reduce to Mindlin's result for isotropic plates as
a special case. When the infinite series is truncated,
the first-order approximation yields for the shell the
stress equations of motion of the usual type, the strain-
displacement relations given previously by Sanders,
and, with the exception of those for transverse shearing
stresses and strains, the stress-strain relations that
are reducible to those given by Reissner.

2139

Polytechnic Inst. of Brooklyn. Dept. of Mechanical
Engineering, N. Y.

GENERALIZED HAMILTON'S PRINCIPLE AND VARIA-
TIONAL EQUATION OF MOTION IN NONLINEAR ELAS-
TICITY THEORY, WITH APPLICATION TO PLATE
THEORY, by Y.-Y. Yu. [1964] [10]p. incl. refs.
(AFOSR-64-0912) (AF AFOSR-63-60) AD 439867
Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 111-120, Jan. 1964.

A generalized Hamilton's principle and the associated variational equation of motion are presented for finite elastic deformations. By means of the generalized variational equation of motion, it is possible to deduce immediately the usual nonlinear equations of elasticity, such as were discussed by Novozhilov. The inconsistency in Novozhilov's work for a simplified nonlinear case of technical importance is pointed out. In its linearized version, the generalized variational equation of motion is next employed in the derivation of plate equations for both flexural and extensional motions, which are finally compared with those given by previous authors.

2140

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

VISCOELASTIC DAMPING OF VIBRATIONS OF SANDWICH PLATES AND SHELLS, by Y. -Y. Yu. [1964] [21]p. incl. diagrs. refs. (AFOSR-65-0919) (AF AFOSR-63-60) AD 617987   Unclassified

Also published in Proc. I. A. S. S. Symposium on Non-Classical Shell Problems, Warsaw (Poland) (Sept. 2-5, 1963), Amsterdam, North Holland Publishing Co., 1964, p. 551-571.

This note studies the viscoelastic damping of vibrations of sandwich plates and shells. A variational principle is presented which may be considered as a generalized Hamilton's principle. It is used in the derivation of the complete system of equations for a sandwich cylindrical shell, which are reducible to those of a sandwich plate as a special case. The equations of the sandwich plate and cylindrical shell are then used to investigate the undamped vibrations of these structures. An analysis is given of the coupling between the flexural and extensional motions of the sandwich cylindrical shell as well as a demonstration of the importance of transverse shear deformation in the vibrations of the sandwich plate and cylindrical shell. Finally, the effectiveness of viscoelastic damping of vibrations in the sandwich plate and cylindrical shell is investigated through the use of the concept of the damping parameters.

2141

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

PRESSURE GRADIENTS IN A LIQUID PROPELLANT ROCKET MOTOR, by W. T. Peschke and S. S. Hammer. [1964] [3]p. incl. diagrs. (AFOSR-65-1478) (AF AFOSR-63-86) AD 622838   Unclassified

Also published in AIAA Jour., v. 2: 1467-1469, Aug. 1964.

The characteristic gradients or signatures produced by various injectors are important parameters in determining the stability or instability of a thrust chamber system. In this report various injectors are

tested and data presented both as pressure vs axial distance and pressure gradient vs the average axial distance over which the gradient was computed. The data can be used to establish design criteria for steady-state operation and to predict critical conditions that can exist because of large pressure gradients that result in high heat-transfer rates to the injector face or rocket chamber wall.

2142

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

PROPAGATION OF SOUND IN A REACTING GAS MIXTURE NEAR EQUILIBRIUM, by J. J. Roseman and V. D. Agosta. [1964] 32p. (PIBAL-796) (AFOSR-65-2307) (AF AFOSR-63-86) AD 62790'   Unclassified

Presented at Third Conf. on Performance of High Temperature Systems, Pasadena, Calif., Dec. 7-9, 1964.

The one-dimensional propagation of sound and the significance of the two sound speeds (frozen and equilibrium) is examined in detail for the case of a gas mixture at or near equilibrium, consisting of gases which obey the ideal gas law and Dalton's law of partial pressures and which have all their degrees of freedom fully excited.

2143

Polytechnic Inst. of Brooklyn. Dept. of Physics, N. Y.

TUNGSTEN (110) SURFACE CHARACTERISTICS IN LOW-ENERGY ELECTRON DIFFRACTION, by R. M. Stern. [1964] [3]p. incl. illus. diagrs. (AFOSR-65-0774) (AF 49(638)1369) AD 617828   Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 218-220, Dec. 1, 1964.

This investigation studies the diffraction patterns of tungsten (110) surfaces of crystals. When observed in post accelerated low-energy electron diffraction, the surfaces do not exhibit the expected diffraction pattern. Instead, 3 different patterns are seen: a basic pattern having twofold symmetry, its mirror image, and a superposition of the 2 patterns. This results from an impurity in the crystal which is shown to be carbon. Two possible structures are proposed which would give rise to the 3 patterns: a super-lattice consisting of the points of coincidence of a regular (110) plane mesh with one which has been slightly distorted and rotated by the carbon impurity, and a stable tungsten-carbon compound. The adsorption of oxygen on the tungsten (110) surface is also discussed.

2144

Polytechnic Inst. of Brooklyn. Dept. of Physics, N. Y.

FREE ELECTRON MODEL CALCULATION OF THE DEPENDENCE OF THE ATTENUATION OF TRANSVERSE SOUND WAVES ON A MAGNETIC FIELD

PARALLEL TO THE LATTICE DISPLACEMENT, by H. L. Grubin. [1983] 79p. incl. tables. (AFOSR-4725) (AF AFOSR-82-258) AD 410109   Unclassified

The results of a calculation of the attenuation of ultrasonic waves in a metal when a dc magnetic field is present in a direction parallel to the polarization direction of a sound wave is described. A principal part of the report includes tables of use to anyone interested in attenuation calculations. Graphical results for the case in question are included.

2145

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

WIDE-SENSE MARKOFF SEQUENCES AND RECURSIVE FILTERING, by A. Papoulis. June 25, 1964, 14p. (PIBMRI-1230-84) (AFOSR-64-1375) (AF 49(838)1402) AD 804041   Unclassified

In the introductory section of the paper, the orthogonality principle for random variables is stated and proved. This principle is the basis of all linear mean square estimations. In the second section, a number of basic properties of wide-sense Markoff sequences is given. It is finally shown that recursive filtering is an immediate consequence of the orthogonality principle.

2146

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

DECOMPOSITION AND STATE ASSIGNMENT FOR SEQUENTIAL MACHINES, by Z. Kohavi. Aug. 19, 1964, 33p. incl. diagrs. tables. (PIBMRI-1231-84) (AFOSR-84-1487) (AF 49(638)1402) AD 809253
Unclassified

Necessary and sufficient conditions are developed for two (or more) machines to be cascade decomposable in such a way that both have one common component machine that may be factored and shared by the two machines. To obtain the common machine the concept of implication table is introduced. The implication table is shown to be the state table of the factored machine. It is further shown how machines that do not obey these conditions can be augmented in such a way that the conditions are satisfied and the factoring is possible. The problem of reducing the output circuit is also considered. For machines that do not have any partition with substitution property or partition pairs it is shown how to obtain simpler assignments and output circuits with reduced dependencies by recognizing the partially independent subsets.

2147

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

HIGH-FREQUENCY COMPENSATION OF TRANSIS-

TORS, by S. Deutsch, J. G. Corbellini and others. Aug. 1964 [22]p. incl. diagrs. tables. (PIBMRI-1234-64) (AFOSR-64-1831) (AF 49(838)1402) AD 608131
Unclassified

If a relatively small collector load resistor is used so that the gain of a transistor stage is low, the addition of a peaking coil yields substantial improvements in bandwidth or rise time. Still further improvements result from the use of a peaking capacitor in addition to the coil. Normalized values of L and C are derived for critically damped transient, maximally-flat amplitude and maximally-flat delay designs. The associated response curves are also given. (Contractor's abstract)

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

METHODS OF MEASURING INACCESSIBLE ARBITRARY LINEAR MICROWAVE TWO-PORTS, by H. M. Altschuler. Sept. 8, 1964 [154]p. incl. diagrs. tables, refs. (PIBMRI-1238-64) (AFOSR-64-2367) (AF 49-(638)1402) AD 610730   Unclassified

New methods have been developed which make possible the measurement of the complete network description of inaccessible, arbitrary, linear microwave two-ports located in highly frequency sensitive environments and under the constraint of very low permissible power levels. Here "arbitrary" implies that the unknown two-port, r, may be nonreciprocal or reciprocal, active or passive, and symmetric or asymmetric; "inaccessible" is meant to describe two-port r as being located between two other unknown, perhaps arbitrary, two-ports, x and y, which are of no interest in themselves. The constraint that two-ports x and y cannot be measured independently of each other is also imposed. While the measurement methods and the associated network problems are stressed, the circuitry developed for actually carrying out such measurements and the results of experiments intended to demonstrate the capability of this system are also given.

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROCEEDINGS OF THE SYMPOSIUM ON QUASI-OPTICS, New York June 8-10, 1964, Vol. XIV, ed. by J. Fox. Brooklyn, Polytechnic Press, 1964, 1v. incl. illus. diagrs. tables, refs. (AFOSR-65-0260) (In cooperation with the IEEE and Optical Society of America) (AF 49(838)1402) AD 454666   Unclassified

Papers are presented on the following topics: Quasi-Optic Diffraction; The Progressing Wave Formalism; Generalized Scattering Matrix Analysis of Waveguide Discontinuity Problems; Cerenkov Radiation and Allied Phenomena; Coupling and Conversion Coefficients for Optical Modes; Beam tracing and Applications; Semi-Geometric-Optical Approaches to Scattering Phenomena; and Microwave Model Techniques to Study VLF Radio Propagation in the Earth-Ionosphere Waveguide.

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

SINGULAR LINEAR SEQUENTIAL MACHINES: SOME
FURTHER GROUP PROPERTIES AND CANONICAL
FORM REALIZATIONS, by P. Lavallee. Oct. 12,
1964, 20p. (PIBMRI-1250-64) (AF 49(638)1402)
AD 612642   Unclassified

Singular autonomous linear sequential machines are
analyzed following simple group properties introduced
by Gill (IEEE Trans. Electron. Comput., v. EC-13:
226-231, June 1964). It is shown that the set of junc-
tion states for the confluence sets form a group, with
as normal subgroup, the sets of states on the cycle
sets. The set of states mapping into the null (0) state
also forms a group called the null tree group. The cy-
cle set group and the null tree group are realized sepa-
rately and the direct sum of these two groups complete-
ly characterizes the operation of the machine. The
null tree is shown to be characterized by a set of m dis-
joint paths: to each of these paths there corresponds a
shift register having as many delay elements as there
are states in that path.

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

A SUMMARY OF CURRENT RESEARCH AT THE
MICROWAVE RESEARCH INSTITUTE, by E. Weber.
Progress rept. no. 26, Apr. 1-Sept. 30, 1964, 149p.
(PIBMRI-R-452.26-64) (AF 49(638)1402) AD 609133
                            Unclassified

Contributions are compiled under six descriptive sub-
ject headings: electromagnetics, plasma electrophysics
and electronics, solid state and materials research,
microwave circuits, network theory, and systems, com-
munications, and control.

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

THE IDENTIFICATION OF OVERDAMPED PROCESSES
IN THE TIME-DOMAIN, by J. M. Mendel. Apr. 19,
1963, 142p. incl. diagrs. tables, refs. (PIBMRI-
1131-63) (AFOSR-4927) (AF AFOSR-62-280)
AD 407687   Unclassified

The problem of characterizing overdamped systems,
from data in the time-domain, by means of exponential
functions is studied. Particular attention is given to:
(1) the choice of a suitable error criterion based upon
performance measures the approximate system is to
meet; (2) the choice of weighting functions and their
effect on the approximations; and (3) the extension of
the orthonormal exponential approximations of Kautz
and Huggins to approximations of any asymptotic-order
in the s-domain.

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Polytechnic Inst. of Brooklyn. [Microwave Research
Inst.] N. Y.

ON SENSITIVITY IN OPTIMAL CONTROL SYSTEMS,
by P. Dorato. [1963] [2]p. (AFOSR-J1522)
(AF AFOSR-62-280) AD 427952   Unclassified

Also published in IEEE Trans. Automatic Control.,
v. AC-8: 256-257, July 1963.

The sensitivity problem in optimal control systems is
discussed and a procedure for sensitivity analysis in
the case of small parameter variations is worked out.
The performance index is set down as a function of the
input where the plant (controlled object) output is re-
lated to the plant input (control input) by a vector dif-
ferential equation. The procedure for the evaluation of
the variations in the performance index due to infinitesi-
mal parameter variations is worked out. The relative
merits of closed-loop and open-loop control with respect
to the sensitivity problem are compared.

2154

Polytechnic Inst. of Brooklyn. [Microwave Research
Inst.] N. Y.

ADAPTIVE CONTROL, by L. Braun and J. G. Truxal.
[1964] [8]p. incl. diagrs. refs. (AFOSR-64-1315)
(AF AFOSR-62-280) AD 444270   Unclassified

Also published in Appl. Mech. Rev., v. 17: 501-508,
July 1964.

Approximately seven years ago, a new control concept
fired up the imaginations of most engineers and scien-
tists working in the field of automatic control. This
was the concept of inclusion within a control system of
the capability to adapt to changes in system input sig-
nals and/or system parameters. This paper is con-
cerned with a brief consideration of the basic concepts
of such systems and certain means which have been de-
vised to implement these concepts.

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Polytechnic Inst. of Brooklyn. [Microwave Research
Inst.] N. Y.

STABILITY ANALYSIS OF NONLINEAR SYSTEMS IN
THE PARAMETER PLANE, by M. L. Shooman. [1964]
[3]p. incl. diagrs. tables, refs. (AFOSR-64-2316)
(AF AFOSR-62-280) AD 452329   Unclassified

Also published in IEEE Trans. Automatic Control, v.
AC-9: 267-269, July 1964.

This paper treats the analysis of nonlinear systems in
the parameter plane. A stability diagram is drawn
using the Routh test or an analog computer to obtain the
stability boundary-(s). The technique may be applied
to a system with one nonlinearity after replacing the
nonlinearity with a describing function model. If the
system contains two type-one nonlinearities, both are

replaced by describing functions models and the system constraints on these models are computed. The latter method is superior to the lumping of the two nonlinearities together with any interstitial dynamics into a frequency dependent describing function, which in most cases is too complex to be practical.

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Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

SENSITIVITY AND STABILITY IN MULTILOOP SYSTEMS, by R. A. Haddad and J. G. Truxal. [1964] [8]p. incl. diagrs. table. (AFOSR-64-2416) (AF AFOSR-62-280)   Unclassified

Also published in Proc. Joint Automatic Control Conf., Stanford U., Calif., June 1964, p. 162-169.

The stability of a multiloop, multiparameter system is studied from the standpoint of the system sensitivity functions. A correlation is found between relative stability with respect to a parameter and the real-frequency behavior of the corresponding sensitivity function. A pair of stability margins, the parameter gain and parameter phase margins, is introduced to provide a quantitative measure of the destabilizing effects of a parameter variation. These margins are shown to be multiloop generalizations of the familiar gain and phase margins of the single-loop servo system.

2157

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

REAL-FREQUENCY STABILITY CRITERIA FOR LINEAR TIME-VARYING SYSTEMS, by J. J. Bongiorno, Jr. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0323) (AF AFOSR-62-280) AD 611742   Unclassified

Also published in Proc. IEEE, v. 52: 832-841, July 1964.

Bounds on the time-varying parameters that are sufficient to insure stability in linear time-varying systems are developed. The important and significant property of the stability criterion developed is that the bounds on the time-varying parameters can be established from the real-frequency characteristics of the time-invariant part of the system. Therefore, the stability criterion is applied easily in high-order systems. Techniques which permit the determination of decaying exponential bounds on the system signals are also presented. The application of the results obtained to parametric devices, satellite attitude control and adaptive systems is illustrated via examples.

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Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

SINGULAR NETWORK ELEMENTS, by H. J. Carlin.

[1964] [6]p. incl. diagrs. (AFOSR-65-0621) (AF AFOSR-62-280) AD 613919   Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-11: 67-72, Mar. 1964.

The properties of n-ports can be examined in terms of simple properties of linear vector spaces. This approach leads to a very general type of network formalism which in turn casts light on the physical realizability (or nonrealizability) of the singular linear network elements: the nullator (simultaneously an open and a short circuit), and the norator (the unique nonreciprocal one-port with arbitrary port voltage and current). Furthermore, a two-port (the "nullor") which combines these two elements can be shown to be a unique active building block which exhibits the extraordinary nature of the two singular one-ports, but which has other properties which make it amenable for use in practical systems.

2159

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ON THE STABILITY OF LINEAR SYSTEMS, by D. C. Youla. [1963] [4]p. (AFOSR-65-0622) (AF AFOSR-62-280) AD 616464   Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-10: 276-279, June 1963.

A linear system is considered which is describable in terms of the input-output equation: $y(t) = \int_0^t W(t, \tau)x(\tau)d\tau$, $t \geq 0$. The stability of a linear system is defined and the theorem established that a linear system of the form given above with two additional requirements is stable if and only if there exists a quite constant C such that $\int_0^t |W(t, \tau)|d\tau < C$.

2160

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ON THE USE OF ORTHOGONAL EXPONENTIALS IN A FEEDBACK APPLICATION, by J. M. Mendel. [1964] [3]p. incl. diagrs. (AFOSR-65-0638) (AF AFOSR-62-280) AD 615354   Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-[9]: 310-312, July 1964.

This paper presents a discussion of the use of orthogonal exponentials in a time domain identification of a plant $f(t)$ located in the forward path of a feedback control system. The identification $f_a(t)$ is subject to the constraint that it is to be used in place of the actual plant in a stability analysis of the closed-loop system.

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

FREQUENCY MODULATION NOISE, by J. T. Frankle.
[1964] [70]p. (PIBMRI-1041-62) (AFOSR-4504)
(AF AFOSR-62-295) AD 608942   Unclassified

The noise characteristics of a commercial FM receiver
were determined experimentally and compared with the
theoretical results of Middleton and Stumpers. The
theoretical solutions are derived on the basis of both
gaussian and rectangular receiver IF characteristics.
The experimental results follow the rectangular solu-
tion for low carrier to noise ratio and the gaussian solu-
tion for high carrier to noise ratio. This is explained
by the characteristics of the receiver and FM noise
theory. A novel technique, employing an envelope de-
tector, is used to measure carrier to noise ratio prior
to the FM detector.

2162

Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

CANONICAL FORM OF TWO TANDEM-CONNECTED
FOUR-PORTS, by A. L. Reynolds. June 1963, 44p.
incl. diagrs. tables. (PIBMRI-1092-62) (AFOSR-
4547) (AF AFOSR-62-295) AD 296228   Unclassified

Under the rather general conditions it is possible to
represent a 4-port by means of an ideal directional-
coupler together with certain 2-ports in each of its
lines. Such a representation is called the 'canonical-
form' of the given 4-port. The canonical-form of two
tandem-connected 4-ports and the coupling coefficient
of the associated ideal directional coupler are deter-
mined. The presentation is of a thoeretical nature.

2163

Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

ERROR CONTROL IN DIGITAL COMMUNICATION, by
A. M. Manders. Jan. 1963, 73p. incl. diagrs.
(PIBMRI-1076-62) (AFOSR-4688) (AF AFOSR-62-295)
AD 402113   Unclassified

A solution to the problem of obtaining the maximum
transmission rate subject to a fixed permissible error
rate and a fixed equipment complexity is studied. The
method by which this is accomplished is to use an error
correcting device (ECD) that examines the signal for
signs that a burst of impulse noise is likely to have oc-
curred. The bits that are in doubt are erased and re-
placed by use of a two-dimensional parity check. This
method allows a few errors to pass undetected by the
ECD and will therefore give a small but definite proba-
bility of errors in the presence of noise bursts. Some
of these errors can be corrected if the code used has
some error correction capability.

2164

Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

ANALYSIS AND SYNTHESIS OF SEQUENTIAL SWITCH-
ING CIRCUITS, by Z. Kohavi. June 1963, 88p. incl.
diagrs. refs. (PIBMRI-1090-62) (AFOSR-4718)
(AF AFOSR-62-295) AD 297066; AD 406097
                                Unclassified

Two of the most difficult problems in the synthesis of
the sequential switching circuits are discussed: the
problem of simplifying the flow tables of completely and
incompletely specified switching functions; and the prob-
lem of assigning the secondary variables to the differ-
ent states of the circuit. A graphical method is devel-
oped for the reduction of the number of states in the se-
quential machine. The method simplifies the techniques
of finding the closed sets of compatibles which from the
new set of states of the reduced machine. The last chap-
ter includes further development of existing methods
for the secondary assignment for both synchronous and
asynchronous sequential machines. A discussion is also
given on the decomposition of sequential machines and
its relations to the secondary assignment. (Contrac-
tor's abstract)

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

THE MATRIX MANIPULATION OF BILINEAR TRANS-
FORMATIONS, by H. M. Altschuler. Apr. 9, 1963,
11p. (PIBMRI-1137-63) (AFOSR-4721) (AF AFOSR-
62-295) AD 403278   Unclassified

The matrix character of bilinear transformations is ex-
plored, "bilinear matrices" are described, and the
rules which govern their use are established. Bilinear
matrices find their application in simplifying many
manipulations which involve bilinear transformations.
Several simple examples of such applications are given
and short tables of bilinear matrices pertinent to micro-
wave networks are included.

2166

Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

SMALL SAMPLE SEQUENTIAL DETECTION, by R. R.
Boorstyn. Apr. 1963, 56p. (PIBMRI-1128-63)
(AFOSR-4722) (AF AFOSR-62-295) AD 403431
                                Unclassified

Wald's sequential analysis was applied to problems in
statistical communications. These techniques are ex-
tended to the class of applications requiring small sam-
ple size, for which the elegant results of Wald are in-
applicable. The method for solution is discussed in
detail and then applied to three examples, two of which
are of extreme importance in communications work --
the normal (Gaussian) and Rayleigh distributions.

Briefly, it is demonstrated that even for very small average sample sizes a significant improvement is obtained.

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

5 REACTANCE 3 TERMINAL PEAKING CIRCUIT, by L. E. Foley. Feb. 28, 1963, 25p. incl. diagrs. tables. (PIBMRI-1119-63) (AFOSR-4724) (AF AFOSR-62-295) AD 400264   Unclassified

A five reactive network with three terminals is analyzed on a normalized basis and compared to the simple RC network which will be called the uncompensated reference. Two capacitive elements in the network represent the division of the distributed parasitic capacitance into lumped elements while the remaining three elements are physical entities. After the parameters for the reactive elements have been selected the normalized equations for amplitude, time delay, and step response are derived and plotted for comparative purposes. Pole-zero plots are also drawn to give a more succinct picture of the networks analyzed.

2168

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE INTERCHANGE OF SOURCE AND DETECTOR IN MICROWAVE MEASUREMENTS, by H. M. Altschuler. Apr. 11, 1963 [17]p. incl. diagrs. (PIBMRI-1149-63) (AFOSR-4830) (AF AFOSR-62-295) AD 403390   Unclassified

The technique for interchanging generator and detector in the impedance measurement of microwave one-ports is a useful, known procedure often applied when low powers are indicated. The necessary and sufficient conditions for the validity of such measurements are critically examined and direct extensions of this technique to similar measurements of reciprocal two-ports are given. A completely separate analysis is necessary when such an interchange is made in the case of an interference bridge to be used for the determination of the scattering parameters of general (active or passive and reciprocal or nonreciprocal) two-ports. This analysis is presented in detail.

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

LONG LINE EFFECT IN CONNECTION WITH CAVITY RESONANCES, by H. M. Altschuler. Apr. 17, 1963, 12p. incl. diagrs. (PIBMRI-1148-63) (AFOSR-4831) (AF AFOSR-62-295)   Unclassified

When resonant cavities are separated from relatively small obstacles by long waveguides, either multiple resonances or resonant frequency shifts may occur.

This long line effect is explored for both transmission and reflection cavities and is found to be much more serious in the former than in the latter case. It can usually be eliminated by matching procedures. (Contractor's abstract)

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SWITCHING NETWORKS BY LINEAR GRAPH THEORY, by P. Lavallee. May 13, 1963, 42p. incl. refs. (PIBMRI-1146-63) (AFOSR-4962) (AF AFOSR-62-295) AD 406896   Unclassified

An analytic tool in the realization of circuit matrices is presented. The method is based on forming linear trees with each row of a fundamental circuit matrix and combining them to form a tree of the graph. With this method, more difficult problems in the synthesis of contact networks by linear graph theory can be considered. A method of simultaneous synthesis is developed in which two or more switching functions are realized by sharing contacts in an optimal form. Finally the multi-terminal procedures are extended to the synthesis of non-bilateral, 1 port switching networks.

2171

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SYNTHESIS OF TWO-TERMINAL CONTACT-DIODE NETWORKS, by E. J. Smith, C. M. Healy, and W. C. W. Mow. Apr. 15, 1963 [25]p. incl. diagrs. refs. (PIBMRI-1144-63) (AFOSR-5086) (AF AFOSR-62-295) AD 410150   Unclassified

An approach to the design of contact-diode networks having different forward and reverse transmission functions is described. Linear graph theory forms the basis for the synthesis procedure which is an extension of Gould's method. The properties of single-diode networks are considered first. For such networks, the two specified forward and reverse transmission functions are mapped onto a single-contact switching function. Next, an oriented circuit matrix is obtained and the synthesis of a graph corresponding to the matrix is attempted on a maximum-loop basis. If no graph exists, the number of columns in the matrix (correspondingly increasing the number of diodes or contacts) must be increased until one such matrix yields a realizable network.

2172

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE DYNAMICS OF GYROSCOPE DAMPING FOR GEOCENTRIC ATTITUDE CONTROL, by M. Messinger and H. E. Parker. May 1963, 119p. incl. diagrs. refs. (PIBMRI-1147-63) (AFOSR-64-0350) (AF AFOSR-62-295) AD 419083   Unclassified

The geocentric attitude stabilization of an earth satel-
lite is studied. The system considered in this report
utilizes differential gravity to control the vehicles ori-
entation and gyroscopes to provide vehicle damping.
Several different gyroscope configurations that provide
indirect gyroscope damping about all three of the vehi-
cle axes are presented. For each of these configura-
tions, the equations governing the dynamics of the sys-
tem are systematically developed in terms of the atti-
tude deviation angles and the parameters of the orbit.
The expressions for the steady state deviation angles
and the torque which must be supplied by gyroscope
torquers are also obtained. (Contractor's abstract, in
part)

2173

Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

NOISE ANALYSIS OF AN AUTOMATIC GAIN CONTROL
SYSTEM, by H. Schachter and L. Bergstein. [1964]
[7]p. incl. diagrs. (AFOSR-64-2138) (AF AFOSR-
62-295) AD 452286   Unclassified

Also published in IEEE Trans. Automatic Control, v.
AC-[9]: 249-255, July 1964.

A common automatic gain control system is analyzed
for a white Gaussian noise input and the effects of the
noise on the gain of the system are found. Relations
are found between the parameters of the system and the
mean and variance of the gain, and the parameters are
determined that will reduce the ripple caused by the
input noise to a minimum. (Contractor's abstract)

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

GENERALIZED TIME-SPACE PERIODIC MODULA-
TION IN CYCLOTRON PARAMETRIC AMPLIFIERS,
by E. S. Cassedy, Jr. Mar. 4, 1963, 15p. (PIBMRI-
1133-63) (AFOSR-65-1720) (AF AFOSR-62-295)
AD 624078   Unclassified

It is proposed to investigate the coupling of electron
beam modes under the influence of parametric pumping
fields. The effects of the complete set of time-space
harmonics are included in the study, as well as addi-
tional coupling mechanisms created by pump harmon-
ics. A particular condition, called the synchronous
harmonic condition, is predicted and proposed for
theoretical and experimental study. None of the time-
space harmonics may be neglected in this condition
created by a traveling wave-quadrupole pumping field.
This condition, fully explored, could be the basis for
a new device: a synchronous harmonic generator. A
comprehensive study of parametric wave coupling in
cyclotron devices is proposed with pump conditions
ranging from dc to the adler type pump and various
pump field configurations considered for the quantita-
tive effects on amplification efficiency and extraneous
coupling. The new approach proposed is the complete

treatment of all harmonics created by the pump modu-
lation, making no assumptions a priori as to which
coupling components are present.

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Polytechnic Inst. of Brooklyn. [Microwave Research
Inst.] N. Y.

PROBING OF THE DYNAMICAL RESPONSE OF A
PLASMA, by H. Friedman. June 1963, 48p. incl. illus.
diagrs. (PIBMRI-1168-63) (AFOSR-65-1721)
(AF AFOSR-62-295) AD 624081   Unclassified

The dynamical response of a gaseous plasma to the
self-induced magnetic fields in a toroid switch tube is
experimentally investigated using a magnetic field probe
and a set of excitation current measurements. The mag-
netic field, experimentally measured, is compared with
the representation of the plasma current distribution
as an ideal current sheet. The excitation current meas-
urements reveal oscillations in the plasma whose de-
tailed nature, unexplainable by the current sheet model,
may yield information on the thermal pressure within
the plasma. (Contractor's abstract)

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

THE ELECTROMAGNETIC FIELDS OF CERTAIN UNI-
AXIALLY ANISOTROPIC DIELECTRIC SLABS, by
F. M. Labianca. Apr. 9, 1963, 41p. (PIBMRI-1151-
63) (AF AFOSR-62-295) AD 405754   Unclassified

Two problems are considered. In the first problem,
the properties of surface waves propagating in a slab
of uniaxially anisotropic dielectric are studied. Two
cases are studied simultaneously, one being the case
where the optical axis is chosen parallel to the slab,
and the other being the case where the optical axis is
chosen perpendicular to the slab. It is found that at any
frequency the resonances are finite in number. In the
second problem, the electromagnetic fields of a uni-
axially anisotropic plasma slab in the presence of a mag-
netic line source are studied. The geometry is the
same as for the first problem, except that the optical
axis is chosen parallel to the slab and perpendicular to
the direction of the line source.

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

STUDY OF THE APPLICATION OF CODING THEORY,
A. E. Laemmel. Final rept. Feb. 27, 1964, 93p.
MRI-1206-64) (AF AFOSR-62-295) AD 601696
Unclassified

This report deals mostly with discrete codes. The
codes which are discussed are used principally to com-
press information into the fewest possible digits, and
little attention is given to error-reducing codes.

Several other aspects of coding processes beside information-compression are considered and some coding
process results might better be classified under finite
state machine theory. Also, some attention has been
given to digital computer design and synthesis.

2178

Polytechnic Inst. of Brooklyn. [Microwave Research
Inst.] N. Y.

SECONDARY STATE ASSIGNMENT FOR SEQUENTIAL
MACHINES, by Z. Kohavi. Mar. 1963, 26p. (PIBMRI-
1174-63) (AFOSR-5159) (AF AFOSR-63-453)
AD 409277   Unclassified

Also published in IEEE Trans. on Electron. Comput.,
v. EC-13: 193-203, June 1964.

A method is presented for obtaining for any given machine, M, an equivalent machine, M, which has a partition with the substitution property and therefore can
be decomposed into several submachines connected in
cascade or in parallel. It is also shown that for machine M we can find an assignment with self dependent
subsets. The method is shown to be general for any
completely or incompletely specified sequential
machine.

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

OPTIMAL MULTIPLICATIVE CONTROL, by A.
Bhojwani and P. Dorato. June 1964, 65p. (PIBMRI-
1210-64) (AFOSR-64-1119) (AF AFOSR-63-453)
AD 601536   Unclassified

This study is concerned with the optimal control of systems whose dynamics are represented by n first order
differential equations. The systems are linear and deterministic. The performance indices considered are
(1) the mean squared error, (2) the regulator problem,
and (3) the minimum time problem. Pontryagin's maximum principle is used to derive the optimization equations for each of the above problems. The general
theory is illustrated by various first and second order
examples. A short discussion of the problem of
stability and singular control is included.

2180

Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

UNIAXIAL DIELECTRIC RODS IN CYLINDRICAL
CAVITIES, by R. F. Lohr, Jr. Apr. 1964, 50p.
(PIBMRI-1219-64) (AFOSR-64-1120) (AF AFOSR-
63-453) AD 601693   Unclassified

In frequency regions well above the lowest resonant
frequencies of a circularly cylindrical cavity, the
mode density, i.e., the number of modes within a
given, relatively small frequency interval, is generally

quite high, and the identification of experimentally
found resonances with specific cavity modes cannot
usually be accomplished by frequency considerations
alone. Two techniques useful in such identifications
are presented here. One of these can be employed to
gain information concerning the angular periodicity, of
the mode, while the other gives an indication of its axial periodicity. A new method of measuring the dielectric constants (tensor) of a uniaxial material, which is
based on the exact solution of a large dielectric rod located in a circularly cylindrical cavity is also presented.

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Polytechnic Inst. of Brooklyn. Microwave Research
Inst., N. Y.

EFFECTS OF A STATIC MAGNETIC FIELD ON THE
CHARACTERISTICS OF A HELIUM-NEON LASER, by
P. Fenster. Apr. 1964, 39p. (PIBMRI-1222-64)
(AFOSR-64-1121) (AF AFOSR-63-453) AD 601694
                                       Unclassified

The application of even modest magnetic fields to the
amplifying material in the helium-neon laser profoundly modifies the operational characteristics of the laser.
The magnetic field introduces a Faraday effect and a
Zeeman effect. Both of these effects tend to reduce the
power output of the laser. A simple theory is set forth
which describes the impact of these effects on the output. The experimental work which was carried out with
a laser oscillating at a wavelength of 6328 A is generally in agreement with the theory. An attempt is made to
explain some observed deviations from the expected
results

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Polytechnic Inst. of Brooklyn. [Microwave Research
Inst.] N. Y.

RESONANT MODES OF OPTIC INTERFEROMETER
CAVITIES. I. PLANE-PARALLEL END REFLEC
TORS, by L. Bergstein and H. Schachter. [1964] [17]p.
incl. diagrs. tables, refs. (AFOSR-64-1909)
(AF AFOSR-63-453) AD 450313   Unclassified

Also published in Jour. Opt. Soc. Amer., v. 54: 887-
903, July 1964.

A study is made of the resonant or normal modes of optic and quasioptic interferometer cavities with plane-
parallel end reflectors. The solution of the integral
equation governing the relation between the normal
modes and the geometry of the cavity is found by means
of a series expansion of orthogonal functions. The
terms of the series for the normal modes can be interpreted as Fraunhofer diffraction patterns characteristic
of the geometry of the end reflectors. Various geometries, such as the infinite-strip, rectangular, and circular end reflector cavities, are considered and the results plotted and interpreted.

2163

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

A FAST SWITCHING HIGH POWER C BAND FERRITE CIRCULATOR, by L. M. Silber and A. Weis. [1964] 5p. incl. diagrs. (AFOSR-64-2226) (AF AFOSR-63-453) AD 452370   Unclassified

Also published in IEEE Internat'l. Conv. Record, Part 2, 1964, p. 32-36.

A differential phase shift circulator for C band was developed using non-reciprocal transverse field ferrite elements of novel configuration. In this configuration the non-reciprocal phase shifters are constructed using ferrite toroids with a wire running axially inside the ferrite to magnetize it to remanence. This replaces the usual double ferrite slabs and external magnet. This configuration realizes two advantages. First, the magnetizing coil is inside the waveguide rather than outside and it is not necessary to propagate the switching pulse through the waveguide walls. Second, the ferrite toroids form a closed magnetic path. This allows the ferrite, once magnetized, to remain at remanence without having to maintain the magnetizing current. The device switched at all peak powers up to 550 kw, in 20 nano sec or less.

2164

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ANALYSIS OF A DISTRIBUTED COUPLING STRIP LINE CIRCULATOR, by Y. Konishi. July 31, 1963 [35]p. incl. diagrs. refs. (PIBMRI-1160-63) (AFOSR-65-1722) (AF AFOSR-63-453) AD 624079   Unclassified

This paper proposes and analyzes a new type or circulator — the distributed coupling strip line circulator. It has parallel coupled strip lines partially loaded with dielectric material in order to obtain circular polarization on its surface. A ferrite bar is put on the surface of the dielectric. The equivalent circuit of the circulator is developed, and design formulas are derived for calculating the values of the elements of the equivalent circuit. (Contractor's abstract)

2165

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A SIMPLE APPROACH TO THE ZERO-CROSSING PROBLEM, by A. Papoulis. Oct. 1, 1963, 6p. incl. diagr. (PIBMRI-1194-63) (AFOSR-65-1723) (AF AFOSR-63-453) AD 624265   Unclassified

Given a normal stationary process $x(t)$ with zero mean, the probability $p(\Delta t)$ that $x(t) = 0$ is solved for some t

in the interval $(t_0,\ t_0 + \Delta t)$. It is found that $\cos [\pi p(\Delta t)] = \dfrac{R(\Delta t)}{R(0)}$, where $R(\tau)$ is the autocorrelation of $x(t)$.

2166

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

EXPANSION OF A NON-PERIODIC PROCESS $x(t)$ INTO A FOURIER SERIES WITH UNCORRELATED COEFFICIENTS, by A. Papoulis. Jan. 15, 1964, 7p. incl. diagr. (PIBMRI-1203-64) (AFOSR-65-1724) (AF AFOSR-63-453) AD 624266   Unclassified

If a stationary non-periodic process $x(t)$ is expanded into a Fourier series in an interval $|t| < T/2$, then the coefficients of the expansion are not orthogonal. In this note it is shown that $x(t)$ can be approximated by a series $x(t) \sim \sum_n b_n e^{jn\omega_0 t}$ $\omega_0 = \dfrac{2\pi}{T}$ whose coefficients are exactly orthogonal $E\{b_n b^*_m\} = 0\ n \neq m$. The approximation improves with increasing n. (Contractor's abstract)

2167

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

ERGODICITY OF THE DISTRIBUTION FUNCTION OF A STATIONERY PROCESS, by A. Papoulis. Jan. 20, 1964, 4p. incl. diagr. (PIBMRI-1205-64) (AFOSR-65-1725) (AF AFOSR-63-453) AD 624307   Unclassified

Given a stationary process $x(t)$ with one and two-dimensional distribution functions $F(x) = P\{x(t) \leq x\}$ $F(x_1,\ x_2;\tau) = P\{x(t+\tau) \leq x_1,\ x(t) \leq x_2\}$ respectively, it is shown that, with $y(x, t) = \begin{cases} 1 \text{ if } x(t) \leq x \\ 0 \text{ if } x(t) > x \end{cases}$ the time average $\bar{y}_T (t) = \dfrac{1}{2T} \int_{-T}^{T} y(x_1 t) dt$ tends to $F(x)$ in the m. s. sense, provided, $\lim_{T \to \infty} \dfrac{1}{T} \int_0^{2T} (1 - \dfrac{\tau}{2T})$ $[F(x, x, \tau) - F^2 (x)] d\tau = 0.$

2168

Polytechnic Inst. of Brooklyn. Microwave Research Inst. , N. Y.

A CLASS OF SOLID-BURST ERROR-CORRECTING CODES, by A. G. Schillinger. Apr. 1964 [72]p. incl. diagrs. refs. (PIBMRI-1223-64) (AFOSR-66-0047) (AF AFOSR-63-453) AD 637475   Unclassified

An efficient class of codes which correct errors in

adjacent digits (solid bursts) is derived. Several properties of polynomials over GF(2) are found and these lead to the choice of generator polynomials g(x) of $(2^m -1, 2^m-1-2m)$ cyclic codes which correct errors in $2^{m-1}-1$ adjacent digits or less per codeword. Algebraic properties of cyclic codes in general are considered next by examining the structure of the parity check matrix H. Among several simple relationships which are shown to exist one finds that the columns of H can be always chosen to form a cyclic group.

2189

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

FIVE-REACTANCE BROADBAND COMPENSATION DESIGNS, by B. M. Albrecht, Jr. June 1964, 37p. (PIBMRI-1218-64) (AF AFOSR-63-453) AD 600449
Unclassified

The most detrimental factor to the high frequency response of an amplifier is the total parasitic capacitance that shunts the output terminals. In particular, this shunt capacitance causes serious distortion to the step response and the amplitude response of the amplifier. Nevertheless, considerable improvement of the high frequency response can be achieved by the addition of a filter to the output terminals. This report shows the design of such a filter having five reactive elements, and a constant voltage source with a finite internal impedance.

2190

Pomona Coll. [Dept. of Physics] Claremont, Calif.

X-RAY FLUORESCENCE ANALYSIS FOR SODIUM, FLUORINE, OXYGEN, NITROGEN, CARBON, AND BORON, by B. L. Henke. [1964] [29]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1913) (AF AFOSR-62-415) AD 450506
Unclassified

Also published in Advan. X-ray Anal., v. 7: 460-488, 1964.

Optimized vacuum spectrographic measurement of low-energy fluorescence has been found to yield counting rates and peak-to-background ratios which are enough to permit the extension of fluorescence analysis for elementary chemistry into the light-element range—sodium through boron. This is accomplished with an efficient, demountable ultrasoft x-ray source, with close coupling among source, crystal, and detector, with KAP and multilayered stearate analyzers, and with optimized flow-proportional counting. Specific methods for achieving peak-to-background ratios on practical samples containing these light elements are presented. The extension of these methods of light-element analysis with the use of curved long-spaced crystals for x-ray macroprobe and electron microprobe measurements is discussed. The design and construction of multilayered soap film "crystals" for long-wavelength x-ray analysis is described. (Contractor's abstract)

2191

Pomona Coll. [Dept. of Physics] Claremont, Calif.

REFLECTION EFFICIENCIES OF A PERIODIC ABSORBING SURFACE, by J. C. Miller. [1964] [4]p. incl. diagrs. (AFOSR-64-1961) (AF AFOSR-62-415) AD 453597
Unclassified

Also published in Jour. Opt. Soc. Amer., v. 54: 353-356, Mar. 1964.

The reflection efficiencies for the various orders of diffraction produced by a grating are calculated under the following assumptions. The grating is for the most part flat, but with a fraction ϵ of the periodicity interval a described by a profile function $z = f(x)$. The reflection and transmission efficiencies are calculated as a series expansion in ϵ. Numerical calculations have been performed for the case of ultrasoft x rays incident at near grazing angles, using a complex index of refraction $\eta = 1 - \delta_0\lambda^2 + i\beta_0\lambda^{3.25}$ or tabulated values. No effects of shadowing by the grating profile have been considered, and the numerical work has been done for a symmetrical triangular trench incised in the flat surface. (Contractor's abstract)

2192

Pontifical Catholic U. of Rio de Janeiro (Brazil).

EFFECT OF PENETRATING RADIATION ON THE PERSISTENT INTERNAL POLARIZATION OF CARNAUBA WAX ELECTRETS, by P. V. Murphy, S. C. Ribeiro and others. [1963] [2]p. (AFOSR-64-1990) (AF AFOSR-61-140) AD 452332   Unclassified

Also published in Jour. Appl. Phys., v. 34: 338-339, 1963.

The discharge of the persistent internal polarization of carnauba wax electrets by gamma rays has recently been reported on by Gross and de Moraes. The decrease of residual polarization with radiation dose was approximately exponential. However, measurements of samples exposed to a high dose were subject to considerable uncertainty due to a voltaic effect caused by the thermal gradient in the measuring system. In the present work, irradiation experiments on electrets have been extended using an improved measuring system. Samples of different thicknesses have been studied, and irradiations have been carried out at ambient temperature and at reduced temperatures. The results differ from those of the earlier work in that the relation between residual polarization and radiation dose cannot be approximated by a simple exponential.

2193

Princeton U. [Dept. of Aeronautical Engineering] N. J.

MEASUREMENT OF MEAN PARTICLE SIZES OF

SPRAYS FROM DIFFRACTIVELY SCATTERED LIGHT, by R. A. Dobbins, L. Crocco, and I. Glassman. [1983] [5]p. incl. diagrs. tables, refs. (AFOSR-J1082) (AF 18(600)1527)   Unclassified

Also published in AIAA Jour., v. 1: 1882-1888, Aug. 1963.

The angular distribution of scattering for polydispersion of particles distributed according to the upper limit distribution function is examined and found to lack the sensitivity necessary to permit determination of size distribution. However, the volume-to-surface mean diameter is found to be directly dependent upon angular distribution of intensity for a wide variety of shapes of the distribution function. Therefore, the combination of both a scattering experiment together with a transmission experiment can be used to obtain both particle concentration and volume-to-surface mean diameter of particles in a spray.

2194

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

THE DEVELOPMENT OF A SMALL MACH 10 HYPERSONIC WIND TUNNEL, by N. A. Zarin and I. E. Vas. Mar. 1963 [28]p. incl. illus. diagrs. refs. (Rept. no. 666) (AFOSR-5329) (AF 49(638)465) AD 424293
                                                Unclassified

A hypersonic wind tunnel was constructed at the Gas Dynamics Laboratory using air as the working fluid. This tunnel, capable of operating from Mach 5 to 10 at Reynolds numbers per in. of 0.03 to 0.40 million, has a test section diameter of 3 1/4 in. The key part of the installation is a storage heater which consists of a coil of heavy-walled inconel pipe which is preheated electrically to the desired stagnation temperature. A maximum temperature of 2000°R at a pressure of 1500 psia is generated for running times of 6 to 12 m.n. Preliminary calibration tests using conical nozzies at M = 7 and 10 have verified the basic design and operating range. (Contractor's abstract)

2195

Princeton U. Dept. of Aerospace and Mechanical Sciences, N. J.

THE GAS PHASE DECOMPOSITION OF HYDRAZINE PROPELLANTS, by I. J. Eberstein. 1964, 1v. incl. illus. diagrs. tables, refs. (Rept. no. 708) (AFOSR-84-2034) (AF 49(838)1288) AD 807334   Unclassified

The decomposition of hydrazine, hydrazine-water mixtures, UDMH, and monomethylhydrazine were studied in the Princeton adiabatic flow reactor. The overall reaction order of all three monopropellants was found to be very close to unity. A comparison of the reaction rates showed that, in the temperature regime of this study, UDMH decomposition is fastest, hydrazine decomposition is slowest, and the monomethylhydrazine decomposition rate is intermediate. A study of hydrazine-water mixtures showed their rates to be

slower than those of the anhydrous material by approximately a factor of 10, and independent of the amount of water added.

2198

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

THE LANGMUIR PROBE IN A COLLISIONLESS PLASMA, by S. H. Lam. Mar. 1964 [64]p. incl. diagrs. tables. (Rept. no. 681) (AFOSR-84-0353) (AF 49-(638)1271) AD 434842   Unclassified

This paper presents an asymptotic analysis of the Langmuir probe problem in a quiescent, collisionless plasma in the limit of large body dimension to Debye length ratio. The structures of the electric potential distribution about spheres and cylinders are analyzed and dircussed in detail. It is shown that when the probe potential is smaller than approx $1/2$-KT, where T is the undisturbed temperature of the repelled particles, there exists no sheath adjacent to the solid surface. At large body potentials, for which a sheath is present, the electric potential distribution is given in terms of several universal functions.

2197

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

THE COMBINATORY INTEGRAL TRANSFORM AND ITS APPLICATION TO HEUN'S EQUATION, by H. H. Chiu and S. I. Cheng. Feb. 1964, 31p. incl. diagrs. (Rept. no. 678) (AFOSR-84-0899) (AF 49(638)1271) AD 606090   Unclassified

The combinatory integral transforms mean the successive application of the Euler and the Laplace transforms in proper combination. Solutions to a certain class of Heun's equations and many classes of third order equations can be obtained through the use of the combinatory transform. Several properties of the Euler and the Laplace integral transforms are developed in Sections 2 and 3. The combinatory transform is studied in Section 4. The application of this transform in solving a Heun's equation is demonstrated in Section 5.

2198

Princeton U. Dept. of Aerospace and Mechanical Sciences, N. J.

THE PRINCETON UNIVERSITY HIGH PRESSURE HYPERSONIC NITROGEN TUNNEL N-3. PART I. FACILITY DESCRIPTION. PART II. CALCULATION OF GAS CHARACTERISTICS AND EVALUATION OF EFFECTS OF VIBRATIONAL NON-EQUILIBRIUM. PART III. PRELIMINARY MEASUREMENTS, by I. E. Vas and G. Koppenwallner. July 1964 [100]p. incl. illus. diagrs. tables, refs. (Rept. no. 890) (AFOSR-64-1422) (AF 49(838)1271) AD 808588   Unclassified

A hypersonic wind tunnel using nitrogen as the test

wave-shaped walls are superposed to yield recirculatory flow patterns for such cavities. It is found that the flow at low and moderately low Reynolds numbers does not separate from the corner at the upstream end, and at low Reynolds numbers it is much easier to create an extensive length of flow with greatly reduced skin friction than a truly recirculatory cavity flow.

2199

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

MARKOV CHAIN THEORY OF FREE-MOLECULE FLOW, by Y. Wu. Dec. 1964, 19p. (Rept. no. 711) (AFOSR-65-0193) (AF 49(638)1271) AD 622566
Unclassified

A mathematical model is proposed which describes the motion of each molecule of free-molecule flow by a probability distribution function in a multi-reflection system. The probability function is determined by its initial probability function and successive transition probabilities in a discrete sample space. The successive transition probability functions are determined from the diffuse reflection law and the geometry of the system, and are independent of time. Such a mathematical model is equivalent to a stationary Markov chain process in probability theory. Two examples are presented of free molecular flow through a sphere and through multi-connected spheres.

2200

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

ON A NEW ULTRA-HIGH VACUUM PUMP, by Y. Wu. Dec. 1964 [12]p. incl. diagrs. tables. (Rept. no. 715) (AFOSR-65-0194) (AF 49(638)1271) AD 615149
Unclassified

The theory of highly rarefied cascade flow has been presented, and a proposal for a new axial-flow pump in the free-molecule range has been made. An unconventional cascade has been suggested which will produce an extremely high compression ratio, up to 30,000, in a single stage at very high blade speed, $S = V_b / \sqrt{2RT} = 20$. This new pump can be used to reach any ultrahigh vacuum state, i.e. an almost empty state.

2201

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

ROTATIONAL STAGNATION POINT FLOW, by W. D. Hayes. [1964] [9]p. (AFOSR-65-0555) (AF 49(638)-1271) AD 613732
Unclassified

Also published in Jour. Fluid Mech., v. 19: 366-374, 1964.

The constant-density inviscid rotational flow in the

neighborhood of a general stagnation point on a wall is investigated. In all but very special cases, the solution is non-analytic and the vorticity at the wall is infinite; the stagnation streamline is tangent to the wall at the stagnation point; stagnation points of saddle-point type cannot exist. The boundary-layer equations corresponding to the inviscid solutions studied are presented.

2202

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

THE RESPONSE OF PRESTRESSED ALUMINUM, by O. W. Dillon, Jr. [1964] [13]p. (AFOSR-64-1882) (AF 49(638)1306) AD 449996
Unclassified

Experimental data on the propagation of changes in strain associated with an unstable load are presented. These deformations frequently propagate at speeds which are less than 10 in/sec. These large amplitude deformations are the result of adding small increments of the load at long time intervals. The wave speed calculated from the Karman-Taylor wave theory and based on a smooth stress-strain relation for the material is 18000 in/sec. One large change in strain propagates at an average speed of 0.0037 in/sec. These slowly propagating deformations occur only at certain discrete loads in prestressed specimens of annealed aluminum. Between these loads, the response is approximately that of a linearly elastic material. Some data on preloaded specimens tested in a torsional impact apparatus are also included.

2203

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

RESEARCH ON SOLID PROPELLANT IGNITABILITY AND IGNITER CHARACTERISTICS, by E. H. Grant, Jr. and J. Wenograd. Final technical rept. Oct. 1, 1961-Sept. 30, 1962. Oct. 31, 1963, 1v. incl. illus. diagrs. tables, refs. (Rept. no. 662) (AFOSR-J1467) (AF AFOSR-62-91) AD 425651
Unclassified

The purpose of this research was to study the ignition of composite solid propellants in a small rocket motor. Hot gaseous products from a small gas-fed pyrogen-type igniter supplied a convective ignition stimulus to the internal surface of a thin-webbed, cylindrical solid propellant grain. The gas rocket igniter is a valuable tool for investigating the essential nature of the ignition process because it offers a wide range of controllable parameters such as heat transfer, chemical reactivity of the igniting gas, flame temperature, mass flow, chamber pressure and solid propellant compositions.

2204

Princeton U. Dept. of Aerospace and Mechanical Sciences, N. J.

RESEARCH ON SOLID PROPELLANT COMBUSTION

fluid was built to operate in the continuum and slip flow regimes. The free stream Mach number in the 6-8 in. diam test section varies from 16-25 with stagnation pressures from 2000-5000 psia and stagnation temperatures to 3000°K. The testing time is presently limited to 25 min. For the temperatures and pressures encountered, no dissociation effects are experienced but vibrational effects must be included. A freezing criterion was developed and applied to the nozzle configuration. For the operating conditions, it was found that the gas can be considered to be frozen during the entire expansion process. Measurements of wall static pressure and transverse pitot pressure traces were conducted in the test region generated by the conical nozzle. The effect of stagnation pressure on Mach number was found to be important.

2205

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

A CRITICAL EXAMINATION OF THE FLUID DYNAMIC PROBLEM POSED BY THE LAMINAR JET DIFFUSION FLAME, by A. Goldburg and S. I. Cheng. July 1964, 56p. (Rept. no. 702) (AFOSR-64-1595) (AF 49(638)-1271) AD 606770   Unclassified

The paper discusses the laminar diffusion flame: a combustion process which occurs in a region which is located in the mixing zone between the undiluted fuel and the undiluted oxidizer and in which the mixing is carried out by molecular diffusion only. The boundary layer similar solutions are oresented for the relevant distributions of the physical properties and species concentrations in a planar laminar jet diffusion flame.

2206

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

LAMINAR SEPARATED FLOW WITHIN REJOINING OR REATTACHING BOUNDARY LAYERS, by S. I. Cheng. July 1964, 44p. (Rept. no. 701) (AFOSR-64-1596) (AF 49(636)1271) AD 608208   Unclassified

The separated flow next to where the supersonic boundary layers rejoin or reattach was studied with the Navier-Stokes equations around the stagnation point, enclosed between the boundary layers. For the separated, recirculatory flow to be dynamically possible, it was found that at the rear stagnation point the rejoining wake flow must possess: (1) a parabolic dividing streamline (D.S.L.), (2) a proper axial pressure gradient, and (3) an outer inviscid stream parallel to the axis of symmetry of the recirculatory flow. Likewise, at the reattachment point, the recirculatory flow must possess (1) a linear D.S.L., (2) a positive axial pressure gradient and (3) a given ratio for the slopes of the inviscid streamline over the reattachment point and of the stagnating D.S.L. A model for the analysis of the recirculatory wake is discussed.

2207

Princeton U. Dept. of Aerospace and Mechanical Sciences, N. J.

PARTICLE IMPINGEMENT ON A NOZZLE WALL, by S. I. Cheng and Y. Rimon. July 1964 [28]p. incl. diagrs. table. (Rept. no. 696) (AFOSR-64-1659) (AF 49(638)1271) AD 612267   Unclassified

The percentage of the mass flux of fine particles carried in a two phase fluid that impinge on the wall of the convergent section of a nozzle is investigated. If the particles are uniformly distributed over the nozzle entrance and if the diameter of the particles is less than $5\,\mu$, the particles in the turbulent core outside the displacement area of the turbulent boundary layer on the wall of the rocket chamber will pass through. The percentage of particle mass flux that impinges on the nozzle wall is very small. Most of the impingement takes place in the entrance region, where the heat transfer condition is not so severe as is in the throat region. The percentage mass flux of particle impingement is insensitive to nozzle shape near the throat but depends heavily on the nozzle geometry near the entrance.

2208

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

HYPERSONIC FLOW OVER A WEDGE WITH UP-STREAM NON-UNIFORMITIES AND VARIABLE WEDGE ANGLE, by A. R. George. Dec. 1964 [137]p. incl. diagrs. table. (Rept. no. 695) (AFOSR-65-0002) (AF 49(636)1271) AD 612286   Unclassified

The paper analyzes the supersonic and hypersonic flow over a wedge placed in a parallel but non-uniform free stream. The free stream property or velocity gradients are assumed to be small and in the spanwise direction. The substitution principle allows the transformation of a general non-uniform parallel free stream into one with constant velocity. In both the supersonic and hypersonic cases a perturbation analysis is used giving linear theories. Thus superposition is valid under certain restrictions and the problem treated is taken to be a small spanwise step in free stream properties. As the flow will then be conical the problem may be reduced to dependence upon only two independent variables.

2209

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

INCOMPRESSIBLE CAVITY FLOWS IN TWO DIMENSIONS AT LOW REYNOLDS NUMBER, by H. J. Hagerup. June 1964 [33]p. incl. diagrs. (Rept. no. 691) (AFOSR-65-0056) (AF 49(636)1271)
                    Unclassified

Steady, 2-dimensional shear flow is studied at low and moderately low Reynolds numbers past shallow surface depressions with slope discontinuities at the ends. Linearized solutions for simple shear flow past

INSTABILITY, by R. H. Woodward and J. Wenograd.
Final technical rept. May 1, 1962-Apr. 30, 1963.
Apr. 1, 1964 [24]p. incl. illus. diagrs. tables, refs.
(Rept. no. 635) (AFOSR-4693) (AF AFOSR-62-460)
Unclassified

One previously developed explanation of combustion in-
stability is that the driving disturbance originates with
a pressure interaction between the surface flame and
the oscillating gas field. A clue to the nature of the
acoustic interaction should be obtainable by a measure-
ment of the entropy variation in the gas emerging from
the thin flame. An experimental search for entropy
waves and attempts to measure entropy variations were
made with high-speed cinematography and with spectral
radiometry, using a 2 in. I.D. T-tube rocket combus-
tor. Waves of the expected length (order of 1 cm) have
been observed at frequencies about 200 cps and mean
pressures about 900 psi with AP-nitrocellulose com-
posite propellant. In experiments with conventional
AP composite propellants at similar frequencies, but
lower mean pressures and larger amplitudes (+ 25% p),
more complicated wave structures were observed, and
in one experiment, the entropy amplitude was zero, a
surprising result. No firm explanations have yet been
found. (Contractor's abstract, in part)

2210

Princeton U. [Dept. of Aerospace and Mechanical
Sciences] N. J.

A CRITICAL REVIEW OF RECENT RESEARCH ON
THE MECHANISM OF IGNITION OF SOLID ROCKET
PROPELLANTS, by M. Summerfield, R. Shinnar and
others. Aug. 26, 1963, 1v. (Rept. no. 661) (AFOSR-
5311) (AF AFOSR-63-92) AD 416332; AD 419882
Unclassified

Presented at Fourteenth Cong. of the Internat'l. Astro-
nautics Federation, Paris (France), Sept. 1963.
(AFOSR-J1017; AD 419166)

A number of experimental techniques varying in form
and concept have been used to study the ignition of
composite and nitrate ester propellants. Both slow
and fast ignitions have been studied, and ignition de-
lays have ranged from 20 sec down to less than a msec.
In the experiments which have been conducted, the pro-
pellants have been heated by hot wires, test furnaces of
various types, flowing gas streams at elevated tem-
peratures, shock tubes and shock tunnels, highly reac-
tive oxidizing gases, arc-image furnaces, etc. This
review contains a description of the various theories
which have been used to account for the phenomenon
of propellant ignition, a discussion of the experimen-
tal methods which have been applied to this study, and
an evaluation of the reported results.

2211

Princeton U. [Dept. of Aerospace and Mechanical
Sciences] N. J.

SOLID PROPELLANT IGNITION STUDIES: IGNITION
OF THE REACTION FIELD ADJACENT TO THE

SURFACE OF A SOLID PROPELLANT, by C. E.
Hermance, R. Shinnar, and J. Wenograd. Final tech-
nical rept. Oct. 1, 1962-Sept. 30, 1963. Dec. 1, 1963,
108p. (Rept. no. 674) (AF AFOSR-63-92) AD 428602
Unclassified

The object of this research was to elucidate ignition
mechanisms of solid propellants, to identify the com-
ponent processes, and to lay the basis for a theory of ig-
nition. Experiments were performed in which compos-
ite propellant samples and polymeric fuel samples were
exposed to high and low speed flows of oxygen containing
gases at high temperature and pressure in a shock tun-
nel. Ignition of either propellant or fuel could not be ob-
tained in high speed flows even in pure oxygen; in addi-
tion, no charring or decomposition of the fuel was ob-
served. At low flow speeds, on the other hand, igni-
tion of the composite propellant and the polymeric fuel
did occur, and the ignition delay was found to depend on
the gas phase oxygen concentration.

2212

Princeton U. [Dept. of Aerospace and Mechanical
Sciences] N. J.

A GENERAL THEORY FOR THE FLOW OF WEAKLY
IONIZED GASES, by S. H. Lam. Apr. 1963, 1v.
(Rept. no. 644) (AFOSR-4662) (AF AFOSR-63-112)
AD 416367 Unclassified

A general theory is developed for the flow of a weakly
ionized gas about arbitrary solid body or bodies with
absorbing surfaces. The main interest lies in the pre-
diction of the electrical response on the body surface as
a function of the pertinent properties of the flow. The
theory is based on continuum formulation, and is valid
when (1) the mean-free-path of the charged particles
is at most the order of a Debye length and (2) the Debye
length is much smaller than the thickness of the bound-
ary layer adjacent to the body surface. The entire
range of flow velocity in terms of an electric Reynolds
number R is investigated. It is found that the electrical
disturbances can be divided distinctly into three physic-
ally distinct but mathematically uncoupled regions,
namely the outer region, the ambi-polar diffusion re-
gion, and the sheath region.

2213

Princeton U. [Dept. of Aerospace and Mechanical
Sciences] N. J.

EXPERIMENTAL LAMINAR HEAT TRANSFER FROM
AN OSCILLATING FLAT PLATE, by N. A. Evans.
Feb. 1963, 1v. (Rept. no. 639) (AFOSR-4906)
(AF AFOSR-63-112) AD 420993; AD 423312
Unclassified

An externally-heated ceramic flat plate, instrumented
on both surfaces with short time response platinum film
resistance thermometers, was used to compare the am-
plitude of the additional unsteady heat transfer rate, dur-
ing oscillation in its own plane in a steady parallel air
stream, with the corresponding steady state heat trans-
fer rate without oscillation. The theoretical treatments

considered the case of constant plate surface temperature, while practical experimental limitations produced an approximate parabolic surface temperature distribution.

2214

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

A THEORETICAL ANALYSIS OF HEAT TRANSFER IN REGIONS OF REVERSE FLOW, by R. W. Garvine. June 1963, 23p. (Rept. no. 652) (AFOSR-5330) (AF AFOSR-63-112) AD 424398   Unclassified

Inquiry is made into a fundamental aspect of heat transfer in a laminar flow where separation has induced a reverse or backward moving layer of fluid. A Couette flow model is chosen with linear velocity profile but with a portion of the profile reversed. In this model, the features of simultaneous upstream and downstream convection are retained. Analytic solutions are found for the case of a sinusoidal wall temperature. It is concluded that the convection effect of the reverse layer cannot be ignored in practical cases.

2215

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

FURTHER DEVELOPMENT OF A GRAPHITE HEATER FOR HIGH PRESSURE NITROGEN OPERATION, by L. E. Vas and J. K. Harvey. Oct. 1963 [22]p. incl. illus. diagrs. (Rept. no. 669) (AFOSR-5440) (AF AFOSR-63-112) AD 600010   Unclassified

An experimental study was conducted to extend the operation of a graphite resistance nitrogen heater to pressures above the 1000 psi previously obtained. Using a somewhat modified design, a single pass spiral heater element was fabricated and tested at 5000 psi and 5000°R. Test runs of 5 to 15 min were carried out with total operating times at elevated temperatures and pressure exceeding several hours using the same element. The temperature was determined by the mass flow technique and checked against a thermocouple installed in the stagnation chamber. (Contractor's abstract)

2216

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

INTERACTIONS OF HEAT TRANSFER AND HYPERSONIC BOUNDARY LAYERS UNDER HIGHLY FAVORABLE PRESSURE GRADIENTS, by S. H. Lam. [1963] [14]p. (AFOSR-J846) (AF AFOSR-63-112) AD 416385   Unclassified

Also published in Proc. Heat Transfer and Fluid Mechanics Inst., Calif. Inst. of Tech., Pasadena (June 12-14, 1963), Stanford U. Press, 1963, p. 44-57.

The boundary layer in a hypersonic nozzle is studied. The main interest lies in the interaction between the wall thermal condition and the development of the boundary layer itself. It is shown that for reasonable nozzle shapes and for high values of γ, the Falkner-Skan pressure gradient parameter, β, is generally large. Taking advantage of this observation, the boundary layer on the nozzle walls is analyzed in detail by means of the method of inner and outer expansions.

2217

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

MASS FLOW THROUGH A CIRCULAR ORIFICE AND A TWO-DIMENSIONAL SLIT AT HIGH KNUDSEN NUMBERS, by D. R. Willis. Mar. 1964, 32p. (Rept. no. 683) (AFOSR-64-0858) (AF AFOSR-63-112) AD 600968   Unclassified

This paper presents the results of numerical calculations of the total mass flow through both a circular orifice and a two-dimensional slit. The calculations are restricted to one iteration in the integral iteration scheme and the effect of molecules which, due to collision, return through the orifice is neglected. No further simplifying assumptions, such as those used by Narasimha, are employed.

2218

Princeton U. Dept. of Chemical Engineering, N. J.

KINETICS OF THE BRANCHING STEP IN THE REACTION OF HYDROGEN WITH OXYGEN, by S. C. Kurzius. Doctoral thesis, Dec. 1964, 136p. incl. diagrs. tables, refs. (AFOSR-66-1311) (AF 49(638)-32) AD 635159   Unclassified

Lower explosion limits in hydrogen-oxygen and deuterium-oxygen mixtures have been measured in the diffusion regime. From the data, the rate constants for the reaction $H + O_2 — OH + O$ and its isotope effect are calculated between 800 and 1000°K. Both the absolute rate theory and the classical collision theory of reactions fail to explain the apparently reliable experimental observations. A theory is presented for reactions of essentially zero activation energy which, when applied to the above reaction and its reverse, leads to a rate constant expression which is a hybrid between that of the absolute rate theory and that of the classical collision theory of reactions. Subsidiary observations and theory related to the kinetics of the branching reaction and its elucidation by the method of explosion limits are reported.

2219

Princeton U. [Dept. of Chemistry] N. J.

REDOX ANALYSIS OF CRYOGENICALLY STABLE PRODUCTS OF DISSOCIATED WATER VAPOR, by

H. M. Gladney and D. Garvin. 1963, 8p. (Technical note no. 9) (AFOSR-1266) (AF 18(603)134)
AD 434509   Unclassified

A study is reported of the oxidizing and reducing powers of the products that can be frozen at liquid nitrogen temperature from water vapor dissociated by an electrodeless discharge. The frozen material exhibits a greater oxidizing and reducing power than does the solution formed after melting of the products. This extra titer does not show a stoichiometric relation to the oxygen evolved upon warming. The ratio of oxidation to reduction equivalents is about 1:2. It is suggested that the unstable species is either H_2O_3 or H_2O_4.

2220

Princeton U. [Dept. of Chemistry] N. J.

PHOTONOMETRIC TITRATIONS, by C. G. Enke. Final rept. Sept. 1, 1958-Aug. 31, 1963, 9p. (AFOSR-65-1443) (AF 49(638)467) AD 621272   Unclassified

The possibility of using light as a quantitative reagent in chemical reactions was investigated. Photolytic reactions with a reproducible quantum yield and whose products are generally useful analytical reagents, e.g., oxidizing or reducing agents, were studied. The photochemical generation of hydrogen peroxide from solutions of various organic acids was investigated for quantitative interest. It was found that dissolved oxygen was a required reactant and determined directly the amount of peroxide formed. Photochemical generation of reactant was used for the photolytic determination of trace amounts of organic material in water. The technique proved to be extremely sensitive. A list of resulting publications is included.

2221

Princeton U. Dept. of Chemistry, N. J.

SOLVENT EFFECTS ON THE INFRARED FREQUENCY OF THE N—C BAND IN ISONITRILES AND THE SIGN OF ∂_u/∂_r, by W. D. Horrocks, Jr. and R. H. Mann. [1963] [10]p. incl. diagrs. tables, refs. (AFOSR-J1155) (AF AFOSR-63-242) AD 423130
Unclassified

Also published in Spectrochim. Acta, v. 19: 1375-1384, 1963.

Spectra in the N—C stretching region are recorded for t-butyl and p-tolyl isonitriles in the vapor phase and in solution in 14 solvents. A number of solvents were found to shift the N—C band to frequencies higher than the vapor-phase value. Bands due to the N—C bond in co-ordinated isonitriles in molecules of the type $Co(CO)(NO)(RNC)_2$ in the same solvents are also reported. The N—C band shifts in solution correlate qualitatively with the theory of Drickamer and co-workers and allow us to assign a negative sign to $\partial\mu/\partial r$ for the N—C stretching vibration. A band at

frequencies considerably higher than the vapor phase value is found for solutions of isonitriles in hydrogen bonding solvents. (Contractor's abstract)

2222

Princeton U. Dept. of Chemistry, N. J.

INFRARED SPECTROSCOPIC STUDY OF ISONITRILE DERIVATIVES OF THE IRON CARBONYL HALIDES, by R. C. Taylor and W. D. Horrocks, Jr. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1517) (AF AFOSR-63-242) AD 446135   Unclassified

Also published in Inorg. Chem., v. 3: 584-589, Apr. 1964.

The complexes $Fe(CO)_{4-n}(CNR)_nX_2$, where n = o-4, R = p-tolyl or t-butyl, and X = Cl, Br, or I, were prepared and the infrared spectra studied in the carbonyl and isonitrile stretching regions. The π-electron accepting abilities of the coordinated carbonyl and isonitrile groups are discussed. Structures of a number of these compounds are postulated on the basis of the number and intensity of the observed infrared bands. Spectral shifts in a series of compounds are found to correlate well with the electronegativities of the halogens. (Contractor's abstract)

2223

Princeton U. [Dept. of Chemistry] N. J.

ISOTROPIC PROTON MAGNETIC RESONANCE SHIFTS IN PI BONDING LIGANDS COORDINATED TO PARAMAGNETIC NICKEL (II) AND COBALT (II) ACETYLACETONATES, by W. D. Horrocks, Jr., R. C. Taylor, and G. N. LaMar. [1964] [6]p. (AFOSR-64-1792) (AF AFOSR-63-242) AD 449050   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3031-3038, Aug. 1964.

Isotropic proton magnetic resonance shifts due to contact and pseudo-contact interactions have been observed for protons in certain triaryl-phosphines and isonitrile molecules when these are placed in solution in CDCl3 with the paramagnetic Ni(II) and Co(II) acetylacetonates. The alternation in sign of the observed shifts for adjacent protons on the phenyl rings is evidence for delocalization of spin density into the π-orbitals of these ligands when coordinated to both Co(II) and Ni(II) acetylacetonates. Evidence for a large upfield pseudo-contact shift in the cobalt systems is presented. Proton spin-spin coupling constants for the arylphosphines and isonitriles are given.

2224

Princeton U. [Dept. of Chemistry] N. J.

ISOTROPIC PROTON RESONANCE SHIFTS OF SOME BIS-(TRIARYLPHOSPHINE) COMPLEXES OF

COBALT(II) AND NICKEL(I!) DIHALIDES, by G. N. La Mar, W. D. Horrocks, Jr., and L. C. Allen. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0688) (AF AFOSR-63-242) AD 615687 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2126-2134, Oct. 1964.

Isotropic proton resonance shifts have been observed for some bis-(triarylphosphine) complexes of cobalt(II) and nickel(II) dihalides. The equations for the pseudocontact shifts were extended to include these complexes which possess g tensors with C_{2v} symmetry.

The isotropic shifts for the nickel complexes are interpreted as arising solely from a contact interaction with unpaired spin in the π orbital of the ligand. Based on the postulate that unpaired spin will distribute itself in the same way in a given ligand whether attached to cobalt or nickel, the shifts for the cobalt complexes are separated into contact and pseudocontact contributions. The relative magnitudes of the pseudocontact shifts correspond well with the expected relative strength of the C_{2v} distortion of the tetrahedral ligand field of the cobalt complexes.

2225

Princeton U. [Dept. of Chemistry] N. J.

ISOTROPIC SHIFTS OF SOME IONIC COMPLEXES OF COBALT(II) AND NICKEL(II) EVIDENCE FOR ION PAIRING, by G. N. La Mar. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0885) (AF AFOSR-63-242) AD 618444 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2992-2998, Nov. 15, 1964.

Isotropic proton resonance shifts have been observed for the ionic complexes, $[Bu_4N][(\varphi_3P)CoI_3]$ and $[Bu_4N][(\varphi_3P)NiI_3]$. In addition to the phenyl (φ) proton shifts for the complex anions, isotropic shifts were observed for the cation protons as well. These shifts for the tetra-n-butylammonium cations are interpreted as arising solely from a pseudocontact interaction with the metal in the complex anion through partial ion pairing in the deuterochloroform solutions. From the magnitudes of the shifts for the butyl protons, an estimate is made for the relative extent of g-tensor anisotropies for the 2 anionic complexes. The observed shifts for the phenyl protons are interpreted as arising from both contact and pseudocontact interactions.

2226

Princeton U. Dept. of Chemistry, N. J.

INORGANIC STRUCTURE AND SPECTRA, by W. D. Horrocks, Jr. Final rept. Jan. 1, 1963-Dec. 31, 1964, 2p. incl. refs. (AFOSR-65-0980) (AF AFOSR-63-242) AD 618041 Unclassified

A list is presented of the publications completed under this c tract. The publications summarize the work

accomplished. A number of other continuing studies are briefly reported. The work is concerned largely with transition metal complexes.

2227

Princeton U. [Dept. of Chemistry] N. J.

EXPERIMENTAL DATA ON ALUMINUM AS AN UN-STABLE SOLID, by O. W. Dillon, Jr. [1963] [18]p. incl. diagrs. (AFOSR-65-2474) (AF AFOSR-63-406) AD 628398 Unclassified

Data are presented on annealed aluminum where large changes in strain occur long after the load increment has been applied. These changes occur suddenly and frequently, without warning. The specimens are loaded in small increments with many minutes between loads. In this way a good approximation to equilibrium exists at the time the increase in load is added. It is shown that very slow 'waves' exist in the material. This means that in tests made at more conventional loading rates, the material frequently is not actually in equilibrium. These waves travel at speeds which are more than five orders of magnitude slower than those based on conventional test results.

2228

Princeton U. [Dept. of Geology] N. J.

STRUCTURE OF THE EARTH'S CRUST FROM SPEC-TRAL BEHAVIOR OF LONG PERIOD BODY WAVES, by R. A. Phinney. Feb. 1964, 65p. (AF 49(638)1243) AD 432362 Unclassified

Long period P-waves from distant earthquakes have been analyzed at Albuquerque and Bermuda in light of Haskell's theory for the spectral response of a layered crust. By using the ratio of the vertical spectrum to the horizontal component spectrum, one obtains a function which depends on structure beneath the station. Due to the poorly understood nature of the signal which follows the first P motion, the notions of power spectral analysis were applied and a lag window selected to discriminate against long time correlations within the signal. Corrections for the differing responses of the three components are made using the power spectral matrix of calibration signals. At Albuquerque the crust is about 40 km thick and the lower crust has velocities in the range 6.6-7.0 km/sec. The Moho under Bermuda is 12 km below sea level, and the structure appears to be a normal oceanic crust depressed elastically by the weight of the volcanics which compose the island.

2229

Princeton U. [Dept. of Mathematics] N. J.

POTENTIAL-THEORETIC APPROACH TO ANALYTIC BOHR ALMOST PERIODIC FUNCTIONS IN HALF-PLANES, by S. Bochner. [1963] [6]p. (AFOSR-J1264) (AF 49(638)578) AD 424344 Unclassified

Also published in Math. Ann., v. 150: 150-155, 1963.

Results are derived using real variable methods without linking these to the existence and to the properties of the resulting series when there is a boundedness requirement and the function is almost periodic.

2230

[Princeton U. Frick Chemical Lab., N. J.]

A STUDY OF THE KINETICS AND MECHANISM OF ELECTROLYTIC FILM FORMATION REACTIONS, by C. G. Enke. Final rept. Nov. 1, 1962-Oct. 31, 1964 [6]p. (AFOSR-65-1560) (AF AFOSR-63-151) AD 624264   Unclassified

A summary is presented of an investigation on the development of electrochemical tools for studying the electrode-electrolyte interface and on their application to systems of interest. A triangular sweep generator was designed and constructed for use with potential sweeping experiments, and the palladium-hydrogen electrode was studied. Two new techniques for the measurement of double-layer capacitance at solid electrodes were also developed. Capacitance measurements were made on silver electrodes in perchlorate solutions, and a method of wetting a platinum surface with liquid mercury was discovered.

2231

Princeton U. Frick Chemical Lab., N. J.

VERSATILE TRIANGULAR SWEEP GENERATOR, by W. D. Weir and C. G. Enke. [1964] [5]p. incl. diagrs. (AFOSR-65-2197) (AF AFOSR-63-151) AD 625678
                                                Unclassified

Also published in Rev. Scient. Instr., v. 35: 833-837, July 1964.

A versatile, all-electronic cyclic linear-sweep generator is described. This device produces a symmetric or asymmetric triangular waveform of high quality with sweep rates continuously variable from 5 mv/sec to 2000 v/sec, independent of amplitude; positive and negative sweep limits are independently variable from 0-3 v relative to a reference level which is itself variable with respect to signal ground. Provision is made for controlling the output voltage at a preset level, prior to initiation of the sweep, and the sense of the initial sweep may be selected. The cyclic sweep may be halted at either limit, either mechanically or electronically. An auxiliary output provides a square wave with peak-to-peak amplitude equal to the peak-to-peak amplitude of the triangular waveform, based at signal ground, and with period regulated by the sweep rate controls. (Contractor's abstract)

2232

Princeton U. Frick Chemical Lab., N. J.

IONIC COPOLYMERIZATION OF STYRENE AND

p-METHYLSTYRENE, by B. D. Phillips, T. L. Hanlon, and A. V. Tobolsky. [1964] [15]p. incl. tables, refs. (AFOSR-65-2198) (AF AFOSR-63-157)
                                                Unclassified

Also published in Jour. Polymer Sci., Pt. A, v. 2: 4231-4245, 1964.

The copolymerization of styrene and p-methylstyrene has been initiated by Friedel-Crafts metal halides, benzoyl peroxide, a Ziegler catalyst from triethylaluminum and titanium tetrachloride, alkali metal dispersions, and alkali metal-naphthalene complexes in a variety of polar and nonpolar solvents. The composition of the initial copolymer from an equimolar monomer mixture was used as the basis for comparison of these systems. By a suitable choice of initiator and solvent, the copolymer composition was varied within the range 25-79 wt.-% styrene. Cationic catalysts yield copolymers with low styrene contents while anionic and electron transfer initiators produce copolymers with high styrene contents. The compositions of the initial copolymers are briefly discussed in relation to the ionic character of the growing polymer-gegenion ion pair and the polarity of the reaction medium. (Contractor's abstract)

2233

Princeton U. [Palmer Physical Lab.] N. J.

NO FUGITIVE AND CLOISTERED VIRTUE, by J. A. Wheeler. [1963] [3]p. incl. illus. (AFOSR-J817) (AF 49(638)304) AD 413767   Unclassified

Also published in Phys. Today, v. 16: 30-32, Jan. 1963.

This note is a tribute to Niels Bohr, who died on Nov. 18th, 1962. It consists of an address delivered on the occasion of the presentation of the first Atoms for Peace Award to Bohr on Oct. 24, 1957 in Washington, D. C.

2234

Princeton U. Palmer Physical Lab., N. J.

PROOF OF A CONJECTURE OF S. WEINBERG, by W. Hunziker. [1964] [4]p. (AFOSR-64-2130) (AF 49(638)-1333) AD 452424   Unclassified

Also published in Phys. Rev., v. 135: B800-B803, Aug. 10, 1964.

A proof is given of Weinberg's conjecture that the irreducible N-particle kernel is of Hilbert-Schmidt type if the potentials, which describe the pair interactions, are square integrable.

2235

Princeton U. [Palmer Physical Lab.] N. J.

TESTS OF THE CONSERVED VECTOR CURRENT AND

PARTIALLY CONSERVED AXIAL-VECTOR CURRENT
HYPOTHESES IN HIGH-ENERGY NEUTRINO REAC-
TIONS, by S. L. Adler. [1964] [4]p. (AFOSR-64-2131)
(AF 49(638)1333) AD 452426　　　　Unclassified

Also published in Phys. Rev., v. 135: B963-B966,
Aug. 24, 1964.

Tests of the conserved vector current and the partially
conserved axial-vector current hypotheses, based on
the theorem given in the report, are proposed.

2236

Princeton U. [Palmer Physical Lab.] N. J.

COLLISION THEORY, by M. L. Goldberger and K. M.
Watson. New York, Wiley and Sons, 1964, 919p. incl.
diagrs. refs. (AFOSR-65-0839) (AF 49(638)1333)
　　　　　　　　　　　　　　　　Unclassified

General scattering theory is presented and extensively
illustrated with applications to elementary particles,
nuclear, and atomic physics. The theory and observa-
tions are discussed of collisions between particles and
systems of particles. The relationship of observation
and theory is developed first, with careful attention to
a proper wave packed description of scattering proc-
esses. The role of symmetry principles in limiting the
variety and kinds of events is then discussed systemat-
ically, including symmetrization for identical particles,
time reversal invariance, and angular momentum con-
servation. Formal scattering theory and powerful al-
gebraic techniques are developed and illustrated by
examples. The rest of the book is devoted to applica-
tions.

2237

Princeton U. [Palmer Physical Lab.] N. J.

PCT, SPIN AND STATISTICS, AND ALL THAT, by
R. F. Streater and A. S. Wightman. New York,
W. A. Benjamin, Inc., 1964, 181p. incl. diagrs. refs.
(AFOSR-65-0840) (AF 49(638)1333)　　Unclassified

This book is an exposition of general insights into field
theory as elucidated by research in quantum field
theory. The first of four chapters contains a summary
of the transformation properties of physical states in
relativistic quantum mechanics and provides a language
in which physical states with simple transformation
properties have a simple description. The second chap-
ter is an exposition of the mathematical tools that are
required, and the third defines the notion of field as it
is used in the book. It is shown that a field theory is
defined by the vacuum expectation values of products
of field operators. In Chapter 4 the three preparatory
chapters are applied to get some general theorems of
quantum field theory, of which the PCT theorem and
the theorem on the connection of spin with statistics
are the best known.

2238

Princeton U. Palmer Physical Lab., N. J.

PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF
PHYSICS "ENRICO FERMI"; COURSE 29 ON DISPER-
SION RELATIONS AND THEIR CONNECTION WITH
CAUSALITY, Varenna (Italy), July 15-Aug. 3, 1963,
ed. by E. P. Wigner. New York, Academic Press,
1964 [265]p. incl. illus. diagrs. tables, refs. (AFOSR-
65-0841) (AF 49(638)1333) AD 618420　Unclassified

The aim of the lecture series was to present the main
steps to follow in the standard proof of dispersion rela-
tions. Seven papers which were presented in course
number 29 are contained in this book. These papers
are: (1) The Role of Invariance Principles in Natural
Philosophy, by E. P. Wigner; (2) The Proof of Disper-
sion Relations, by M. Froissart; (3) Causality, R-
Matrix, and Collision Matrix, by E. P. Wigner; (4)
Dispersion Relations and Applications, by D. Y. Wong;
(5) The Nonrelativistic Angular-Momentum Plane, by
R. G. Newton; (6) Production Amplitudes, by P. V.
Landshoff; and (7) High-Energy Scattering and Disper-
sion Theory, by R. Oehme.

2239

Princeton U. Palmer Physical Lab., N. J.

LIFETIME AND DECAY OF UNSTABLE PARTICLES
IN S-MATRIX THEORY, by M. L. Goldberger and
K. M. Watson. [1964] [9]p. incl. diagrs. (AFOSR-65-
0842) (AF 49(638)1333) AD 616048　　Unclassified

Also published in Phys. Rev., v. 136: B1472-B1480,
Dec. 7, 1964.

An investigation is made of the possible time dependence
of decay laws for unstable particles. A simple treat-
ment is given of the decay of unstable states within the
framework of conventional nonrelativistic quantum
theory and carried over further into the relativistic re-
gime. The possibility of nonexponential decays is dis-
cussed, and an experiment for the detection of unstable
particle decays is described. The probability of unsta-
ble particle decay is expressed in terms of S-matrix
quantities, and conclusions indicate that the exponential
decay law $P = e^{-\Gamma t}$ is only one of a discrete set of pos-
sible decay laws.

2240

Princeton U. Palmer Physical Lab., N. J.

AMPLITUDE BOUND IN LADDER GRAPH MODELS.
II, by G. Tiktopoulos and S. B. Treiman. [1964] [4]p.
incl. diagrs. (AFOSR-65-0843) (AF 49(638)1333)
AD 617210　　　　　　　　　　　　Unclassified

Also published in Phys. Rev., v. 136: B1217-B1220,
Nov. 23, 1964.

A procedure described earlier for bounding ladder-
graph scattering amplitudes is applied here to two mod-
els: exchange of pairs of scalar particles, bubbles, and

exchange of vector particles. The forward-scattering absorptive amplitudes are bounded from above. Apart from logarithmic factors, the correct amplitudes are known to grow with energy like S^α, and the results determine upper bounds on the exponents α. For the case where the exchanged particles are massless, the upper bounds in fact coincide with the exact results for α as given in the literature.

2241

Princeton U. Palmer Physical Lab., N. J.

THE VACUUM TRAJECTORY IN CONVENTIONAL FIELD THEORY, by M. Gell-Mann, M. L. Goldberger, and F. E. Low. [1964] [10]p. incl. diagrs. tables. (AFOSR-65-1062) (AF 49(638)1333) AD 618282
Unclassified

Also published in Rev. Modern Phys., v. 36: 640-649, Apr. 1964.

A study is made of the conventional field theory of vector bosons interacting through a conserved current with spin one-half fermions. The generation of a Pomeranchuk-like trajectory is investigated in second-order perturbation theory and is found analogous to the trajectories of potential theory. It is shown that the existence of a perturbation theory vacuum trajectory is consistent with unitarity and analyticity, and the scalar nucleon theory appears to Reggeize as easily for it as the spin 1/2 theory. A description is given of the relevant states of the $\gamma\gamma\,N\bar{N}$ systems, and the different scattering amplitudes are Reggeized.

2242

Princeton U. Palmer Physical Lab., N. J.

SPATIAL SEPARATION OF EVENTS IN S-MATRIX THEORY, by M. Froissart, M. L. Goldberger, and K. M. Watson. [1963] [7]p. incl. diagr. (AFOSR-64-0265) (AF AFOSR-62-390) AD 432750   Unclassified

Also published in Phys. Rev., v. 131: 2820-2826, Sept. 15, 1963.

Just as the derivative of the argument of the S matrix with respect to energy gives a time interval for events, it is shown that the corresponding derivative with respect to momentum transfer gives a space interval. This space interval corresponds to the classical impact parameter in the classical limit. More generally, it is suggested that these two derivatives may provide a basis for introducing space-time intervals into physical theory. (Contractor's abstract)

2243

Princeton U. Palmer Physical Lab., N. J.

USE OF INTENSITY CORRELATIONS TO DETERMINE THE PHASE OF A SCATTERING AMPLITUDE, by M. L. Goldberger. [1963] [24]p. (AFOSR-64-0515) (AF AFOSR-62-390) AD 434316   Unclassified

Also published in Phys. Rev., v. 132: 2764-2787, Dec. 1963.

A new technique is described for observing scattered particles in a scattering experiment. This involves a measurement of the correlated counting rates of two detectors and is based on an idea proposed by Hanbury-Brown and Twiss for astronomical observations. With this technique it is possible, for example, to explicitly measure the phase of a scattering amplitude.

2244

Princeton U. Palmer Physical Lab., N. J.

KHURI-TREIMAN REPRESENTATION AND PERTURBATION THEORY, by J. B. Bronzan and C. Kacser. [1963] [9]p. (AFOSR-64-0526) (AF AFOSR-62-390) AD 436162   Unclassified

Also published in Phys. Rev., v. 132: 2703-2711, Dec. 15, 1963.

It is characteristic of decay amplitudes that the spectral functions for their integral representations have branch points overlapping the integration contour. For the amplitude satisfying the Khuri-Treiman dispersion representation, the prescription for passing the branch points is shown to be incomplete. The full prescription is obtained using pertubation theory as a guide.

2245

Princeton U. Palmer Physical Lab., N. J.

ON THE BORN APPROXIMATION IN THE POTENTIAL SCATTERING OF PARTICLES WITH ARBITRARY SPINS, by F. Calogero and J. M. Charap. [1964] [17]p. (AFOSR-64-0552) (AF AFOSR-62-390) AD 434310
Unclassified

Also published in Ann. Phys., v. 26: 55-71, Jan. 1964.

For abstract see item no. 1124.

2246

Princeton U. Palmer Physical Lab., N. J.

ANALYTICITY PROPERTIES IN ENERGY OF THE COMPLEX J PARTIAL WAVE AMPLITUDES IN THE SCATTERING OF PARTICLES WITH SPIN, by F. Calogero. [1964] [11]p. (AFOSR-64-0553) (AF AFOSR-62-390) AD 434313   Unclassified

Also published in Ann. Phys., v. 26: 44-54, Jan. 1, 1964.

The energy dispersion relations for the complex J partial wave amplitudes for the scattering of particles with arbitrary spin are derived. A discussion is given of the Gribov-Pomeranchuk-Azimov essential singularities, and of a mechanism which might prevent their

propagation to indefinitely large values of J. Some properties of Jacobi functions are collected in an appendix.

2247

Princeton U. Palmer Physical Lab., N. J.

POLARIZATION EFFECTS IN HIGH-ENERGY WEAK INTERACTIONS, by S. L. Adler. [1963] [20]p. (AFOSR-64-0649) (AF AFOSR-62-390) AD 435927
Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 1020-1039, Nov. 16, 1963.

The cross-section for the production of a polarized lepton and baryon reaction is computed. Results are given (a) in covariant form, and (b) in the center-of-mass system of the reaction, expressed directly in terms of the lepton and baryon decay asymmetries. Results are discussed with emphasis on determining the form factors in the strangeness-changing weak interactions, on isolating induced scalar and induced pseudoscalar effects, and on testing time-reversal invariance in high-energy weak interactions.

2248

Princeton U. Palmer Physical Lab., N. J.

ANALYTIC CONTINUATION IN COMPLEX ANGULAR MOMENTUM AND INTEGRAL EQUATIONS, by G. Tiktopoulos. [1964] [8]p. (AFOSR-64-1014) (AF AFOSR-62-390) AD 441059   Unclassified

Also published in Phys. Rev., v. 133: B1231-B1238, Mar. 9, 1964.

An attack is made on the problem of the analytic continuation in the angular momentum variable of amplitudes defined by integral equations beyond the value of Re 1 at which the kernel ceases to be of the Schmidt type and the Fredholm theory cannot be applied. A general technique is developed and applied to the Yukawa potential case.

2249

[Princeton U. Palmer Physical Lab., N. J.]

RESONANCES IN THE SCATTERING OF PSEUDO-SCALAR MESONS, by C. Hong-Mo, P. C. DeCelles, and J. E. Paton. [1964] [24]p. (AFOSR-64-2132) (AF AFOSR-62-390) AD 451929   Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 70-93, July 10, 1964.

The bootstrap mechanism is used to study the resonant scattering of pseudoscalar mesons under the assumption of mass degeneracy and the existence of the vector resonances. The general bootstrap conditions on the mass and the coupling constants are formulated and

Capp's result on SU_3 symmetry is rederived from the more general equations. The question of the possible existence of further resonances is reduced to a simple eigenvalue problem.

2250

Princeton U. Palmer Physical Lab., N. J.

WEAK-COUPLING LIMIT FOR SCATTERING BY STRONGLY SINGULAR POTENTIALS, by G. Tiktopoulos and S. B. Treiman. [1964] [4]p. (AFOSR-64-2133) (AF AFOSR-62-390) AD 452277
Unclassified

Also published in Phys. Rev., v. 134: B844-B847, May 25, 1964.

The validity of certain cutoff procedures, which have lately been employed in the treatment of termwise divergent perturbative expansions in nonrenormalizeable field theories, is investigated in the context of non-relativistic scattering from strongly singular repulsive potentials. For the cases considered the heuristic cut-off prescription indeed yields the correct expression for the weak-coupling limit of the phase shift.

2251

Princeton U. Palmer Physical Lab., N. J.

MEASUREMENT OF TIME CORRELATIONS FOR QUANTUM-MECHANICAL SYSTEMS, by M. L. Goldberger and K. M. Watson. [1964] [10]p. incl. diagr. (AFOSR-64-2134) (AF AFOSR-62-390) AD 452276   Unclassified

Also published in Phys. Rev., v. 134: B919-B928, May 25, 1964.

Measurements that are of limited accuracy, are incomplete, or require a finite time to make, do not generally permit one to construct a wave function for describing a physical system. The use of such partial information to predict the results of subsequent measurements is studied here. There are several practical applications of this problem, including the use of the autocorrelation function for a particle counter in a scattering experiment.

2252

Princeton U. Palmer Physical Lab., N. J.

RELATIVISTIC CALCULATION OF THE DEUTERON ELECTROMAGNETIC FORM FACTOR, I, by F. Gross. [1964] [15]p. (AFOSR-64-2135) (AF AFOSR-62-390) AD 452278   Unclassified

Also published in Phys. Rev., v. 134: B405-B419, Apr. 27, 1964.

The foundations of a relativistic theory of the deuteron electromagnetic form factor are discussed. The theory is based on single-variable unsubtracted dispersion

relations and coupled unitarity equations. Because of the presence of very low anomalous thresholds, only a few diagrams need be considered to give a satisfactory low-momentum transfer theory, and the diagrams with thresholds below 36μ are tabulated. The scalar theory for a subset of these diagrams (corresponding to a one-pion-exchange approximation) is examined and found to be in close correspondence with potential theory. Special attention is given to the anomalous thresholds. The role of the 3-pion state is discussed.

2253

Princeton U. Palmer Physical Lab., N. J.

VARIATIONAL UPPER AND LOWER BOUNDS FOR MULTICHANNEL SCATTERING, by R. Sugar and R. Blankenbecler. [1964] [20]p. (AFOSR-65-0134) (AF AFOSR-62-390) AD 455794   Unclassified

Also published in Phys. Rev., v. 136: B472-B491, Oct. 26, 1964.

Upper and lower variational bounds are given for all elements of the reaction matrix. These, in turn, lead to upper and lower bounds on the elastic and inelastic cross sections. Two-particle scattering, coupled two-particle channels, and three-particle scattering situations are discussed, and the methods will work for any number of particles. Numerical examples are given, including phase shift bounds for S-wave electron-hydrogen scattering. It is hoped that this approach will lead to a tractable calculational scheme for strongly interacting relativistic particles.

2254

Princeton U. Palmer Physical Lab., N. J.

EUCLIDEAN APPROACH TO THE BETHE-SALPETER EQUATION FOR SCATTERING, by G. Tiktopoulos. [1964] [6]p. (AFOSR-65-0135) (AF AFOSR-62-390) AD 455795   Unclassified

Also published in Phys. Rev., v. 136: B275-B280, Oct. 12, 1964.

It is shown that the mass-shell scattering amplitude in the physical scattering region (two particle branch cut) can be directly obtained from the resolvent of the Bethe-Salpeter kernel transformed according to Wick (rotation of the energy integration paths to the imaginary axis). As an illustration and under the assumption that the kernel is approximated by any finite set of irreducible graphs, the scattering amplitude is given in terms of a Fredholm formula whose convergence is explicitly demonstrated.

2255

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. IV. COPPER

(II) AND N-HYDROXYETHYLETHYLENEDIAMINE-TRIACETATONICKELATE(II), by T. J. Bydalek and D. W. Margerum. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1404) (AF 49(638)60) AD 444459   Unclassified

Also published in Jour. Inorg. Chem., v. 2: 678-683, Aug. 1963.

The kinetic expression, for the rate constants, and the activation energy for the copper(II) reaction with the N-hydroxyethylethylenediaminetriacetate (HEEDTA) complex of nickel(II) are nearly identical with the corresponding terms for the copper(II) reaction with the ethylenediaminetetraacetate (EDTA) complex of nickel(II) despite the difference in the coordination of HEEDTA and EDTA. This kinetic behavior is consistent with previously proposed dinuclear reaction intermediates where the multidentate ligand is partially unwrapped from the nickel ion and an iminodiacetate segment is coordinated to the attacking copper ion prior to the rate-determining step. The cleavage of the nickel-nitrogen bond of the last chelate (a glycinate gr) is the probable rate-determining step. (Contractor's abstract)

2256

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. V. COPPER(II) AND CYCLOHEXYLENEDIAMINETETRAACETATO-NICKELATE(II), by D. W. Margerum and T. J. Bydalek. [1963] [6]p. incl. diagrs. tables. (AFOSR-64-1406) (AF 49(638)60) AD 444457   Unclassified

Also published in Jour. Inorg. Chem., v. 2: 683-688, Aug. 1963.

The kinetics of the substitution reaction between the hydrated copper(II) ion and the cyclohexylenediamine-tetraacetatonickelate(II) ion are studied from pH 1.5 to 3.5. In contrast to the dominant role of copper ion attack in the similar reaction with ethylenediaminetetra-acetatonickelate(II), there is no copper ion attack of cyclohexylenediaminetetraacetatonickelate(II). The reaction is first order in the complex and independent of copper concentration but it is highly pH dependent. The acid dissociation rate constants are resolved. (Contractor's abstract, in part)

2257

Purdue U. Dept. of Chemistry, Lafayette, Ind.

EXCHANGE REACTIONS OF MULTIDENTATE LIGAND COMPLEXES, by D. W. Margerum. [1963] [15]p. incl. diagrs. table, refs. (AFOSR-64-1407) (AF 49(638)-60) AD 444456   Unclassified

Also published in Record Chem. Prog., v. 24: 238-251, Dec. 1963.

Exchange reactions of multidentate ligand complexes can be designed to give slow reaction rates even with very labile metal ions. The mechanism of these

exchange reactions can be analyzed successfully in terms of the stability of intermediates bonded to segments of the initial chelate. Good agreement is obtained for the measurement of very fast reaction rates including the rate of loss of the first sphere of water coordinated to a metal ion. The exchange reactions with excess metal ion have proved useful in measuring anion effects on the rate of water loss from metal ions.

2258

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. VI. THE EXCHANGE OF ETHYLENEDIAMINETETRAACETATE ION WITH TRIETHYLENETETRAMINENICKEL(II) AND TETRAETHYLENEPENTAMINENICKEL(II), by D. B. Rorabacher and D. W. Margerum. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-64-1408) (AF 49(638)-60) AD 444319   Unclassified

Also published in Jour. Inorg. Chem., v. 3: 382-390, Mar. 1964.

This displacement of triethylenetetramine and of tetraethylenepentamine from their nickel complexes by EDTA is several orders of magnitude faster than the aqueous dissociation of these complexes at the same pH. The rapid EDTA exchange reactions are studied at 25°C, from pH 5.6 to 11.5 using a cyanide quench and a coordination chain reaction method. The reactions are first order in EDTA and first order in the nickel polyamine. A reaction mechanism is proposed involving a series of mixed ligand intermediate complexes where steric effects prevent full chelation of the six coordination sites of the nickel ion by the two multidentate ligands. The postulated rate-determining step is applicable to EDTA reactions with other metal complexes and with aqueous metal ions.

2259

Purdue U. Dept. of Chemistry, Lafayette, Ind.

CHEMISTRY OF FERROCENE AND RELATED COMPOUNDS, by R. A. Benkesser. Final rept. Jan. 1963, 14p. incl. tables. (AFOSR-4498) (AF 49(638)-297) AD 600969   Unclassified

Research on the following areas of study is summarized: Electrical effects in ferrocene, Addition reactions of vinylferrocene, and Alkylferrocene metalation.

2260

Purdue U. Dept. of Chemistry, Lafayette, Ind.

A RULE OF TRANS-NUCLEOPHILIC ADDITION, by W. E. Truce. Final rept. Jan. 25, 1963, 8p. (AFOSR-4495) (AF 49(638)531) AD 446157
                Unclassified

This report describes the formulation and development of a new chemical rule "The Rule of Trans-Nucleophilic Addition." This rule states that

reactions of addition (e. g., to acetylenic and olefinic systems), initiated by an electron donor, tend to proceed in a steric pattern, such that the nucleophile and displaced electron pair end up trans to each other. It complements the older rule of trans-Nucleophilic Addition, which covers the reverse process. These rules are of general application in organic systems.

2261

Purdue U. Dept. of Chemistry, Lafayette, Ind.

RECENT DEVELOPMENTS IN THE CHEMISTRY OF PERCHLOROPOLYSILANES, by G. Urry. [1964] [6]p. incl. refs. (AFOSR-64-0926) (AF 49(638)927) AD 443942   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 409-414, 1964.

The amine induced disproportionations of disilicon hexachloride and trisilicon octachloride produce Si_5Cl_{12} and Si_6Cl_{14} in good yields. The product is determined by the conditions under which the disproportionation is effected. The implications of the formation of these and higher perchloropolysilanes and a possible mechanism for the disproportionation of the perchloropolysilanes are discussed.

2262

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE PREPARATION AND SOME PROPERTIES OF A NEW PENTASILICON DODECACHLORIDE, Si_5Cl_{12}, by A. Kaczmarczyk, M. Millard and others. [1964] [5]p. incl. tables. (AFOSR-64-0927) (AF 49(638)927) AD 443943   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 421-425, 1964.

The conditions under which pentasilicon dodecachloride is produced in the amine-induced disproportionations of disilicon hexachloride and trisilicon octachloride are described. Some of the physical properties of pentasilicon dodecachloride are given along with descriptions of its chemical reactions with silicon tetrachloride, anhydrous hydrogen chloride and antimony trichloride.

2263

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

COMPLEXES OF DISILICON HEXACHLORIDE WITH TRIMETHYLAMINE, by A. Kaczmarczyk and G. Urry. [1964] [6]p. (AFOSR-64-0928) (AF 49(638)927) AD 443944   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 415-420, 1964.

Disilicon hexachloride forms a well defined complex with trimethylamine, $Si_2Cl_6 \cdot 2N(CH_3)_3$, stable below -45°C. For the reaction $Si_2Cl_6 \cdot 2N(CH_3)_3 = Si_2Cl_6 \cdot N(CH_3)_3 + N(CH_3)_3$ a ΔH of approximately 10 kcal per mole can be obtained. The complex $Si_2Cl_6 \cdot N(CH_3)_3$ is stable below -45°C and exhibits no dissociation pressure below that temperature. At -45°C $Si_2Cl_6 \cdot N(CH_3)_3$ disproportionates slowly, obeying zero order kinetics, to silicon tetrachloride, trimethylamine, and non-stoichiometric complex. When the nonstoichiometric complex is warmed to room temperature, the disproportionation continues until the residual composition is a mixture. As a result of the disproportionations, no ΔH could be obtained for the reaction: $Si_2Cl_6 \cdot N(CH_3)_3 = Si_2Cl_6 + N(CH_3)_3$.

2264

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE PREPARATION AND SOME PROPERTIES OF HEXASILICON TETRADECACHLORIDE, Si_6Cl_{14}, by A. Kaczmarczyk, J. W. Nuss and G. Urry. [1964] [7]p. incl. diagr. table. (AFOSR-64-0929) (AF 49-(638)927) AD 443945   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 427-433, 1964.

The conditions under which hexasilicon tetradecachloride is produced in the trimethylamine-induced disproportionations of disilicon hexachloride and trisilicon octachloride are described. The polymorphism of hexasilicon tetradecachloride is described, along with other known physical properties. The behavior of Si_6Cl_{14} towards trimethylamine, silicon, tetrachloride, trichlorosilane, antimony trichloride and dimethyl zinc is noted. (Contractor's abstract)

2265

Purdue U. Dept. of Chemistry, Lafayette, Ind.

ON THE STRUCTURES OF PENTASILICON DODECACHLORIDE, Si_5Cl_{12}, AND HEXASILICON TETRADECACHLORIDE, Si_6Cl_{14}, by J. W. Nuss and G. Urry. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-64-0930) (AF 49(638)927) AD 443946   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 435-444, 1964.

Pentasilicon dodecachloride, Si_5Cl_{12}, and hexasilicon tetradecachloride, Si_6Cl_{14}, produced in the amine induced disproportionation of disilicon hexachloride, form stoichiometric 1:1 adducts with silicon tetrachloride, methyltrichlorosilane, and dimethyldichlorosilane. These adducts dissociate reversibly and plots of the logarithm of the dissociation pressure vs 1/T yielded straight lines from which the ΔH of dissocia-

tion was calculated. A discussion of the probable bonding in these adducts is presented. The infra-red spectra of pentasilicon dodecachloride and hexasilicon tetradecachloride in the vapor phase and in solutions of methylene chloride and silicon tetrachloride are presented along with a discussion of these spectra elucidating the molecular structure of pentasilicon dodecachloride and hexasilicon tetradecachloride. (Contractor's abstract)

2266

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE SYNTHESIS AND CHARACTERIZATION OF NITRONIC ESTERS, by N. Kornblum and R. A. Brown. [1964] [7]p. incl. table , refs. (AFOSR-64-2266) (AF AFOSR-63-122) AD 452529   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2681-2687, July 5, 1964.

Nitroparaffin salts react with trialkyloxonium fluoroborates to give nearly quantitative yields of nitronic esters. In this way nitronic esters derived from strictly aliphatic nitro compounds have been prepared for the first time. By the use of nuclear magnetic resonance spectroscopy it has been shown that nitronic esters exhibit cis-trans isomerism. Although stable indefinitely at -78°, nitronic esters decompose relatively rapidly at room temperature, particularly in the liquid state or in solution; nitronic esters derived from secondary nitro compounds appear to be less stable than those obtained from primary nitro compounds. Significant differences in decomposition rate are observed for stereoisomeric nitronic esters. (Contractor's abstract)

2267

Purdue U. [Dept. of Physics] Lafayette, Ind.

PHASE REPRESENTATION OF ANALYTIC FUNCTIONS, by M. Sugawara and A. Tubis. [1963] [5]p. (AFOSR-J1250) (AF AFOSR-62-132) AD 424317
Unclassified

Also published in Phys. Rev., v. 130: 2127-2131, June 1, 1963.

The phase representation which expresses an analytic function essentially in terms of its phase (not imaginary part) along the cuts is discussed. In particular, the precise conditions under which this phase representation is valid and also the asymptotic behavior of the phase representation are studied in detail. It is proved that the asymptotic behavior is essentially the same at infinity in all directions. The derivation of the high-energy behavior of scattering amplitudes and the N/D representation of the partial-wave amplitude are discussed as applications of the phase representation. Finally, the phase representation is used in determining the total numbers of zeros of the forward pion-nucleon scattering amplitudes. It is found that the

charge nonexchange amplitude has either 2 or 4 zeros, depending upon the signs of the S-wave scattering lengths, while the charge exchange amplitude has 11 zeros.

2268

Purdue U. [Dept. of Physics] Lafayette, Ind.

UNITARY SYMMETRY AND WEAK INTERACTIONS, by S. P. Rosen. [1964] [4]p. incl. refs. (AFOSR-64-0483) (AF AFOSR-63-274) AD 613814   Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 408-411, Apr. 6, 1964.

The possibility is demonstrated of deriving the relations between the asymmetry parameters within the framework of unitary symmetry, for non-leptonic modes of Σ, Δ, and Ξ decay from the $\Delta T = 1/2$ rule, time reversal invariance, and 2 symmetry principles.

2269

Purdue U. Dept. of Physics, Lafayette, Ind.

SOME PROPERTIES OF TRIANGULAR REPRESENTATIONS OF SU(3), by S. P. Rosen. [1964] [5]p. incl. refs. (AFOSR-65-0484) (AF AFOSR-63-274) AD 613815   Unclassified

Also published in Jour. Math. Phys., v. 5: 289-293, Feb. 1964.

The occurrence of an equal-spacing mass rule in the unitary decuplet can be explained either by observing that the isotopic spin and hypercharge of each particle are related by $T = 1 + 1/2Y$, or by making use of the Diu-Ginibre theorem. This theorem states that, in all triangular representations of SU(3), the matrix elements of an arbitrary tensor operator depend upon one reduced matrix element instead of two. A new proof of the Diu-Ginibre theorem is presented. It shows that relations of the form $T = \lambda \pm 1/2Y$ exist for all triangular representations. It is further shown that the L and K spins are related to their corresponding hypercharges by $L = \lambda \pm 1/2Y_L$ and $K = \lambda \pm 1/2Y_K$. One consequence is that the masses and magnetic moments of particles in a triangular multiplet are equally spaced. Other consequences are also discussed. (Contractor's abstract, modified)

2270

Purdue U. [Dept. of Physics] Lafayette, Ind.

ELECTROPRODUCTION OF NEUTRAL PIONS FROM DEUTERIUM, by S. L. Brown. [1963] [4]p. incl. diagrs. refs. (AFOSR-65-0485) (AF AFOSR-63-274) AD 613802   Unclassified

Also published in Phys. Rev., v. 131: 1330-1333, Aug. 1, 1963.

Making use of the impulse approximation and the 1-nucleon dispersion theoretical amplitudes, a theoretical expression for the differential cross section of the process $e + d \rightarrow e + d + \pi^0$ has been calculated. An experiment which would be useful in the investigation of the nucleon form factors is proposed. At energies near the 3.3 resonance, the cross sections reach values up to 10^{-35} cm^2/mev sr^2, depending on the electronic 4-momentum transfer λ^2. (Contractor's abstract)

2271

Purdue U. Dept. of Physics, Lafayette, Ind.

CONSIDERATIONS ON THE MAGNETIC FIELD PROBLEM IN SUPERCONDUCTING THIN FILMS, by Y. Nambu and S. F. Tuan. [1964] [14]p. incl. diagrs. refs. (AFOSR-65-0486) (AF AFOSR-63-274) AD 613882   Unclassified

Also published in Phys. Rev., v. 133: A14, Jan. 16, 1964.

Previous results on the magnetic field dependence of the energy gap in superconductivity for bulk specimen are adapted to thin-film superconductors. The model of discrete quantization in momentum space is used. Only the parallel and constant external magnetic field along the film surfaces is considered. It is concluded that: (1) a 2nd-order phase transition should be observed at all temperatures for thin-film thicknesses; (2) a simple scaling rule exists for field and temperature dependence on the energy gap; and (3) the critical field H_c depends on thickness L and reduced temperature t for not too thin films. The behavior changes as the film becomes very thin or as the temperature becomes moderately low.

2272

Purdue U. [Dept. of Physics] Lafayette, Ind.

UNITARY SYMMETRY AND THE TRANSFORMATION $\eta \rightarrow \pi^0$, by S. P. Rosen. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0487) (AF AFOSR-63-274) AD 613813   Unclassified

Also published in Phys. Rev., v. 132: 1234-1239, Nov. 1, 1963.

The transformation $\eta \rightarrow \pi^0$, which appears to play a dominant role in the decay mode $\eta \rightarrow \pi^+\pi^-\pi^0$, is examined in the light of unitary symmetry and several different models for η decay. Besides the models of Gell-Mann, Sharp, and Wagner (GSW), and of Barrett and Barton (BB), these include the strong coupling of pseudoscalar and vector meson octets with the unitary singlet vector meson φ, and the electromagnetic coupling of pseudoscalar and vector mesons. Group-theoretical methods are used to confirm that the contributions of all but one of the lowest order diagrams on the GSW model cancel one another. The same methods show that the cancellations in lowest order are not as serious for the BB model, and are nonexistent for models involving the φ meson. (Contractor's abstract)

2273

Purdue U. Dept. of Physics, Lafayette, Ind.

CONSIDERATIONS ON THE ISOBAR MECHANISM AND
RESONANCE POLES FOR PION-BARYON SYSTEMS, by
I. P. Gyuk and S. F. Tuan. [1964] [7]p. incl. diagrs.
table, refs. (AFOSR-65-0494) (AF AFOSR-64-274)
AD 614143   Unclassified

Also published in Nuovo Cimento, Series X, v. 32:
227-233, Apr. 1, 1964.

The Peierls-Hwa theory concerning the generation of
higher resonance poles for pion-baryon systems is dis-
cussed. The role of a resonance pole involving phase-
space factors such that an indirect resonance ($\equiv$(1745
mev)) can occur very close to the singularity in the
Bohr term is explained. It is indicated qualitatively
how the interaction dynamics might intervene to sort
out the correct isospin structure for the predicted
higher resonances. It is also emphasized that kine-
matic and mass ratio considerations are especially
favorable for the $\pi - \equiv$ system.

2274

Purdue U. [Dept. of Physics] Lafayette, Ind.

POSSIBLE EXPERIMENTAL CONSEQUENCES OF TRI-
ANGLE SINGULARITIES IN STRANGE-PARTICLE
PRODUCTION PROCESSES, by Y. F. Chang and S. F.
Tuan. [1964] [8]p. incl. diagrs. tables, refs.
(AFOSR-65-0495) (AF AFOSR-64-274) AD 614144
                                              Unclassified

Also published in Phys. Rev., v. 136: B741-B748,
Nov. 9, 1964.

Observable consequences of anomalous threshold singu-
larity for triangle diagrams are examined with special
reference to cases where baryon resonance of narrow
width participate as an internal line in the E channel.
It is found that the reaction $K^- + p \rightarrow K + \pi + \equiv$, with
$\equiv$ (1530) included as an internal line of the graph,
offers the best experimental situation for detecting an
anomalous singularity effect by studying the $\bar{K}\pi$ mass
spectrum in final state. (Contractor's abstract)

2275

Purdue U. Dept. of Physics, Lafayette, Ind.

ENERGY PEAKS FOR THREE-BODY MESON SYS-
TEMS, by S. F. Tuan. [1964] [3]p. incl. diagrs. refs.
(AFOSR-65-0496) (AF AFOSR-64-274) AD 614150
                                              Unclassified

Also published in Phys. Ltrs., v. 11: 248-250, Aug.
1, 1964.

The unitarity problem is discussed for 3-body meson
systems. No resonance peaking is expected in coupled
channels for meson systems, in particular for the
coupled 3-body final systems of $M_1 + M_{jk} \rightarrow M_1 + M_m +$

M_n. The implications of this theory to $\pi^- \rho$ interaction
at 1100 mev, π-K interaction at 1200 mev, and $\pi\bar{KK}$
peak at 1410 mev are summarized.

2276

Purdue U. Dept. of Physics, Lafayette, Ind.

MESON EFFECTS IN n-p CAPTURE, by G. Stranahan.
[1964] [8]p. incl. diagrs. table, refs. (AFOSR-65-
0497) (AF AFOSR-64-274) AD 614151   Unclassified

Also published in Phys. Rev., v. 135: B953-B960,
Aug. 24, 1964.

A contribution to the n-p capture amplitude which re-
sults from the modification of the nucleon current oper-
ators by the nuclear interaction is calculated. The 2-
nucleon states are represented by Heitler-London
states, and the capture amplitude is related to single-
nucleon matrix elements by means of an expansion cor-
responding to the exchange of mesons between the nu-
cleons. These single-nucleon matrix elements are
evaluated using the fixed-source theory. (Contractor's
abstract, in part)

2277

Purdue U. Dept. of Physics, Lafayette, Ind.

MESON-BARYON SYSTEMS AND THEIR RESONANCES,
by I. P. Gyuk and S. F. Tuan. [1964] [4]p. incl. diagrs.
diagrs. tables, refs. (AFOSR-65-0498) (AF AFOSR-
64-274) AD 614152   Unclassified

Also published in Phys. Rev., v. 134: B1320-B1323,
June 22, 1964.

Meson-baryon systems of angular momentum L are
analyzed by considering the relevant crossing matrices.
The resultant "bootstrap" calculations yield the correct
quantum numbers for the observed array of particles
and resonances. Specifically it is found that Y_1^* (1385)
decays into ($\pi\Delta$) but not ($\pi\Sigma$). Furthermore a Y_1^* reso-
nance in (5/2-) is predicted which may accommodate
the recently discovered Y_1^* (1765).

2278

Purdue U. Dept. of Physics, Lafayette, Ind.

CROSSING RELATIONS AND LEGENDRE EXPANSIONS
IN PION-PION SCATTERING, by T. Kanki and A. Tubis.
[1964] [10]p. incl. diagrs. refs. (AFOSR-65-0499)
(AF AFOSR-64-274) AD 614153   Unclassified

Also published in Phys. Rev., v. 136: B723-B732,
Nov. 9, 1964.

The direct use of crossing relations for pion-pion scat-
tering amplitudes, outside the triangle bordered by the
lines s = 0, t = 0, and u = 0 in the Mandelstam diagram,
is not generally possible. This is because the regions

of convergence of the usual Legendre expansions for the amplitudes are restricted by cross-channel cuts in appropriate $\cos\theta$ variables. These convergence difficulties may be relieved by suitably decomposing each amplitude into 2 terms. One term differs in analytic properties from the actual amplitude in that portions of the cross-channel cuts in $\cos\theta$ nearest $\cos\theta = 1$ are absent. The Legendre expansion of this term has a larger region of convergence than that for the actual amplitude. The other term in the decomposition is expressed in terms of the Legendre series for physical scattering in the cross channels. The amplitudes so represented may now be continued from one physical region to another, and crossing relations may, in general, be directly applied outside the triangle. (Contractor's abstract, in part)

2279

Purdue U. [Dept. of Physics] Lafayette, Ind.

UNITARY SYMMETRY AND WEAK INTERACTIONS. II. SU(3) TRANSFORMATION PROPERTIES, by S. P. Rosen. [1964] [4]p. incl. refs. (AFOSR-65-0609) (AF AFOSR-64-274) AD 614154   Unclassified

Also published in Phys. Rev., v. 135: B1041-B1044, Aug. 24, 1964.

It is shown that if weak interactions are T-L invariant and satisfy the $\Delta T = 1/2$ rule, their SU(3) transformation properties are severely limited. The non-leptonic Hamiltonian must belong to an octet, and the leptonic Hamiltonian is restricted to an octet and decuplet. To prove this result, the matrix elements of certain spin-type operators are expressed in terms of the Casimir operators for SU(3). T-L invariance and the $\Delta T = 1/2$ rule impose constraints upon the eigenvalues of these Casimir operators and hence limit weak interactions in the manner described above. The converse of this result is not true; for example, a Hamiltonian belonging to an octet is not necessarily T-L invariant.

2280

Purdue U. Dept. of Physics, Lafayette, Ind.

SU(6) AND WEAK INTERACTIONS, by S. P. Rosen and S. Pakvasa. [1964] [4]p. incl. refs. (AFOSR-66-0074) (AF AFOSR-64-274) AD 630379   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 773-776, Dec. 21, 1964.

An examination is made of weak interactions in the light of SU(6), with special attention given to the transformation properties of the weak Hamiltonian H_W.

2281

Purdue U. Jet Propulsion Center, Lafayette, Ind.

SUMMARY OF EXPERIMENTAL INVESTIGATIONS OF COMBUSTION PRESSURE OSCILLATIONS IN GASEOUS PROPELLANT ROCKET MOTORS, by M. J. Zucrow, J. R. Osborn, and J. M. Bonnell. Final rept. June 1963, 43p. incl. diagrs. table. (Rept. no. F-63-2) (AFOSR-5261) (AF 49(638)756) AD 416365; AD 417505
                      Unclassified

The experiments conducted were designed for studying the factors promoting combustion pressure oscillations in rocket motors burning either premixed or unmixed gaseous propellants. Investigations were conducted for determining the effects of combustion chamber geometry, the chemical differences in the propellants, and also the effects of several injection variables. Auxiliary studies were conducted regarding the effects of baffles located in the combustion chambers, and the applicability of linear theories to combustion instability phenomena.

2282

Purdue U. [Jet Propulsion Center] Lafayette, Ind.

UNSTABLE BURNING IN SOLID AND LIQUID PROPELLANT ROCKET MOTORS, by J. R. Osborn. [1963] [15]p. (AFOSR-J1084) (AF 49(638)756) AD 421721
                      Unclassified

Also published in Raketentechnik und Raumfahrforschung, v. 2: 47-61, Apr./June 1963.

Presented is the theoretical and experimental effort devoted to the study and analysis of the phenomena associated with unstable burning in both liquid and solid propellant rocket motors. The theoretical developments, particularly those pertaining to liquid propellant engines, have been concerned primarily with deriving mathematical relationships for estimating the frequencies of the combustion pressure oscillations. The experimental investigations pertinent to both types of engines have been pointed to obtain an insight into the phenomena associated with unstable combustion, and data regarding the physical and chemical parameters having the greatest influence upon the severity of the combustion pressure oscillations, and with empirical methods for either avoiding or suppressing them.

2283

Purdue U. Jet Propulsion Center, Lafayette, Ind.

LIMITING CONDITIONS FOR THE ONSET OF COMBUSTION PRESSURE OSCILLATIONS (TRANSVERSE MODE) IN GASEOUS PROPELLANT ROCKET MOTORS, by M. J. Zucrow, J. R. Osborn, and others. 1964, 15p. (AFOSR-64-2018) (AF AFOSR-62-360) AD 451190   Unclassified

Presented at First AIAA annual meeting, Washington, D. C., June 29-July 2, 1964.

An experimental and a theoretical study were made of the high frequency combustion pressure oscillations occurring in rocket motors burning gaseous propellants with the object of determining the influence of the mixing of the propellants and other rocket motor operating conditions upon the onset of the pressure oscillations.

The experiments were conducted with rocket motors of a fixed combustion chamber geometry equipped with different injectors for burning unmixed ethylene and air. The theoretical study was concerned with the derivation of similarity variables that are sensitive to the oscillatory behavior of the combustion process. The analysis is based on the behavior of an idealized rocket motor combustion system divided into four zones. It was determined both theoretically and experimentally that the incidence of combustion pressure oscillations is dependent on a number of dimensionless parameters.

2284

Purdue U. Jet Propulsion Center, Lafayette, Ind.

CONTINUOUS MEASUREMENT OF THE BURNING RATES OF SOLID ROCKET PROPELLANTS, by J. R. Osborn and R. J. Burick. Interim rept. Apr. 1964 [74]p. incl. illus. diagrs. tables. (Rept. no. I-64-3; JPC 369) (AFOSR-64-1479) (AF AFOSR-63-207) AD 601648   Unclassified

An experimental system for the direct and continuous measurement of solid rocket propellant burning rates was developed. A sample of solid propellant is bonded to a holder with an attached shaft which moves the propellant sample within a two-dimensional rocket motor. The flat burning surface of the propellant sample recedes normally as a servo-mechanism moves the propellant in a direction opposite to the receding propellant surface. The servomechanism operates in such a manner that the burning propellant surface is maintained at a fixed position within the rocket motor. Since the burning surface of the propellant remains fixed, the direct measurement of the velocity of the shaft yields the burning rate. The servomechanism incorporates a radioactive isotope feedback transducer system for detecting the position of the burning surface of the propellant sample. A collimated beam of gamma rays, provided by a 50 millicurie source of Cesium-137, is transmitted through the rocket motor walls and is transformed into an electrical feedback signal by a scintillation probe coupled with a linear ratemeter. (Contractor's abstract, in part)

2285

Purdue U. Jet Propulsion Center, Lafayette, Ind.

ANALYSIS OF A SERVO SYSTEM FOR CONTINUOUS MEASUREMENT OF THE BURNING RATE OF A SOLID PROPELLANT, by J. R. Osborn and R. F. Panella. Interim rept. May 1964, 84p. (Rept. no. I-64-4; JPC-374) (AFOSR-64-1480) (AF AFOSR-63-207) AD 604556   Unclassified

The object of this project was to determine the servo system dynamics. Stability, time response and optimization of the servo system were investigated. A theoretical analysis was made to determine component transfer functions. From the component transfer functions the overall system transfer function was derived. The Bode diagram was then used to determine system stability. The system transfer function was

programmed on an analog computer, and the time response of the system was characterized. The servo system was built, and experimental results were obtained to verify the theoretical system transfer function.

2286

Purdue U. Jet Propulsion Center, Lafayette, Ind.

CONTINUOUS MEASUREMENT OF SOLID PROPELLANT BURNING RATES, by J. R. Osborn, R. J. Burick, and R. F. Panella. Final rept. July 1964, 34p. (Rept. no. F-64-3; JPC-386) (AF AFOSR-63-207) AD 615816   Unclassified

Also published in Rev. Scient. Instr., v. 37: 86-92, Jan. 1966. (AFOSR-66-1097; AD 629070)

An experimental apparatus was developed for the direct and continuous measurement of the burning rates of solid rocket propellants under conditions closely approximating those occurring in a solid rocket motor. The apparatus utilizes a positioning type servomechanism as a feed system which moves a sample of solid propellant within a two-dimensional rocket motor so that the receding burning surface of the sample is maintained at a fixed position with respect to the motor walls. Because the burning surface is maintained at a fixed position; the measurement of the velocity of the propellant feed system is identical with the burning rate. The servomechanism incorporates a 50 milli-curie Cesium-137 source of gamma rays coupled with a scintillation probe for detecting the position of the burning propellant surface. Experimental data are reported.

2287

Purdue U. [Jet Propulsion Center] Lafayette, Ind.

LONGITUDINAL MODE INSTABILITY, by J. R. Osborn. [1964] [1]p. incl. refs. (AFOSR-66-1988) (AF AFOSR-65-753) AD 644353   Unclassified

Also published in AIAA Jour., v. 2: 2237, Dec. 1964.

The validity of the time lag theory is questioned. The time lag theory predicts and requires the existence of an upper control length whereas none has been found experimentally in gas-rocket motors. It is noted that the results of theoretical analysis based on an Arrhenius type rate function for the combustion zone dynamics do not indicate the existence of an upper critical length.

2288

Purdue U. School of Electrical Engineering, Lafayette, Ind.

LASER POWER AND ENERGY MEASUREMENT USING NONLINEAR POLARIZATION IN CRYSTALS, by A. K. Kamal and M. Subramanian. [1963] [13]p. (AFOSR-64-0809) (AF AFOSR-62-296) AD 438375
                                                              Unclassified

Also published in Proc. Symposium on Optical Masers, Polytechnic Inst. of Brooklyn, (Apr. 16-19, 1963), p. 601-613.

A high intensity laser beam propagating through a crystalline medium that lacks inversion symmetry develops a dc polarization in the medium. The dc polarization is shown to be directly proportional to the instantaneous power in the laser beam. This principle has been used in demonstrating that a transmission type of device can be built to measure the power in a laser pulse. The energy in the pulse can be determined by passing the output of the device through an integrating circuit.

2289

Purdue U. School of Electrical Engineering, Lafayette, Ind.

PHILOSOPHY AND STATE OF THE ART OF LEARNING CONTROL SYSTEMS, by J. E. Gibson, K. S. Fu and others. Nov. 1963, 118p. incl. diagrs. refs. (AFOSR-5144) (AF AFOSR-62-351) AD 426919
Unclassified

This report is organized into three chapters. The first chapter discusses relevant background material on learning and learning systems. This includes the psychological background of learning and the psychologists' definition of learning. It also includes a brief description and discussion of the learning devices proposed in the literature. Chapter 2 gives the Purdue CISL approach to learning systems. A learning process is defined as applied to control engineering. A discussion of adaptivity and its relationship to learning is included. Chapter 3 presents several different experimental and theoretical approaches to learning control systems which are currently being investigated at Purdue. Some preliminary results on these systems are included. (Contractor's abstract)

2290

Purdue U. School of Electrical Engineering, Lafayette, Ind.

LEARNING CONTROL SYSTEMS, by K. S. Fu. [1964] [26]p. incl. refs. (AFOSR-65-0326) (AF AFOSR-62-351) AD 611935
Unclassified

Also published in Computer and Information Sciences, Spartan Books, Washington, D. C., 1964, p. 318-343.

An informal introduction of learning control systems was presented. A class of learning control systems was described in detail and the basic functions of a learning controller were discussed. Two example

basic functions of a learning controller were discussed. Two example systems were given to illustrate the prepared approach. A complete analytic design procedure of learning control systems is under investigation.

2291

Purdue U. School of Electrical Engineering, Lafayette, Ind.

A HILLCLIMBING TECHNIQUE USING PIECEWISE CUBIC APPROXIMATION, by J. C. Hill. Apr. 1964, 114p. incl. refs. (AFOSR-67-1282) (AF AFOSR-62-351)
Unclassified

Three distinct types of hillclimbing techniques are studied in this thesis. The first is variations of the conventional discrete search as proposed by Bocharov and Fel'dbaum. The second is Kushner's method. The third is the piecewise cubic method, which is developed herein. The last two methods operate by building a model from the measurements obtained. The concept of testing various hillclimbing methods on a relatively large number of randomly selected hills is proposed. A class of such hills is presented, the members of which are capable of exhibiting most of the troublesome features of practical hills. This concept is then applied to evaluate the performance of the three types of hillclimber. Experimental evidence via digital simulation is presented for the superiority of the two model building techniques over the Bocharov and Fel'dbaum methods.

2292

Puerto Rico U., Mayaguez.

INTERPRETATION OF SOME SWEEP-FREQUENCY BACKSCATTER ECHOES, by B. Dueno. [1963] [7]p. (AFOSR-J973) (AF AFOSR-62-408) AD 417143
Unclassified

Also published in Jour. Geophys. Research, v. 68: 3603-3609, June 15, 1963.

A relation is obtained for the condition of minimum time delay focusing for a spherical earth geometry assuming an ionosphere with a parabolic distribution of ion density. Theoretical curves for the case of sweep-frequency backscatter (time delay vs frequency) are obtained that agree well with experimental values. Deductions from theory are made that explain characteristics of backscatter records. A frequency-independent constant time delay (22 msec) backscatter echo frequently observed in the south direction is explained with the help of an expression for the time delay used in deriving the minimum time delay condition.

2293

Radiation Applications, Inc., Long Island, N. Y.

RADIATION-INDUCED SOLID PROPELLANT DECOM-
POSITION, by G. Odian, T. Acker and others. Tech-
nical rept. Dec. 1, 1962-Nov. 30, 1963. Jan. 15, 1964,
30p. (Rept. no. RAI-331) (AF AFOSR-64-1448)
(AF 49(638)1125) AD 604475   Unclassified

An investigation was made of the effect of ionizing radi-
ation on the burning rates and tensile strengths of vari-
ous composite ammonium perchlorate propellants.
The results of these studies demonstrated that, in
many cases, drastic changes in burning rate and ten-
sile strength occurred upon radiolysis. In order to
elucidate the mechanism of these effects, a multi-
pronged study of the effects of radiation on propellants
and propellant components was initiated. This in-
volved: (1) a study of the radiation induced decomposi-
tion of ammonium perchlorate with an elucidation of the
various chemical species produced upon radiolysis and
their yields (G values); (2) a study of radiation effects
on burning rate by a technique in which the effect of
radiation on each of the two components of a propellant,
i. e., organic binder and inorganic oxidizer, is studied
separately.

2294

Radiation Applications, Inc., Long Island, N. Y.

EFFECT OF RADIATION ON AMMONIUM PERCHLOR-
ATE PROPELLANTS, by T. Acker, E. Henley and
others. [1964] [1]p. incl. table. (AFOSR-65-1435)
(AF 49(638)1125) AD 622649   Unclassified

Also published in AIAA Jour., [v. 2: 1165, June 1964].

The results of a series of experiments conducted to de-
termine the effects of radiation on ammonium per-
chlorate propellants are presented. The propellant
strands were irradiated with a 2-mev Van de Graaff
electron accelerator. After exposure to doses from
0-50 mrad, burning rates and tensile measurements
were made. It was demonstrated that in many cases,
drastic changes in burning rates and tensile strngeths
occurred upon radiolysis.

2295

Radio Corp. of America. [Astro-Electronics Div.]
Princeton, N. J.

CONTINUUM ASPECTS OF RF GRADIENT ACCELER-
ATION OF PLASMA, by J. A. Cooney. [1963] [3]p.
incl. diagr. (AFOSR-64-0147) (AF 49(638)658)
AD 432577   Unclassified

Also published in AIAA Jour., v. 1, 2190-2192, Sept.
1963.

A quasi-one-dimensional model of acceleration of a
continuum plasma by rf electric field gradient forces
is examined. The conditions imposed on the electric
field in order to effect sonic transitions are given.

2296

Radio Corp. of America. Astro-Electronics Div.,
Princeton, N. J.

ACCELERATION OF AN ELECTRON CYCLOTRON
PLASMA BY SELF GENERATED ELECTRIC FIELDS,
by H. W. Hendel, S. A. Ahmed, and T. J. Faith.
[1964] [5]p. incl. diagrs. (AFOSR-66-110i) (AF 49-
(638)1342) AD 639010   Unclassified

Also published in Proc. Internat'l. Colloq. on the Inter-
action of High Frequency Fields Associated with Static
Magnetic Field Plasma, Saclay (France), Sept. 16-17,
1964, p. 57-61.

This paper is concerned with the continuous accelera-
tion of a neutral plasma by self-generated electrostatic
fields. Energy input to the plasma is achieved by se-
lective transfer of rf energy to the electrons at electron
cyclotron resonance. With the density in the accelera-
tion region adjusted such that $\omega_{be}\tau \gg i$ the mean path
(parallel to the magnetic field) of the electrons between
collisions is greater than the Larmor radius (the latter
determining the mean free path transverse to B_z). Due
to the tensor nature of the electron diffusion coefficient
in the presence of a magnetic field at low pressures, an
electron space charge is set up by the axial electron
flux that accelerates the ions axially. To maintain
charge neutrality in the beam that emerges from the ac-
celerator and to conserve momentum, the ion accel-
erating plasma potential drop must be nearly totally
reflective for the electrons and therefore adjusts to a
value approximately 6 times higher than the electron
temperature. Consequently the final ion energy in the
beam is 6 times the thermal energy of the plasma
electrons.

2297

Radio Corp. of America. RCA Labs., Princeton, N. J.

AN ANALYSIS OF AN APPROXIMATE SEQUENTIAL
PROCEDURE FOR INTERVAL ESTIMATION, by D. A.
Walters. July 1963, 101p. incl. diagrs. tables. (Tech-
nical note no. 1) (AFOSR-5155) (AF 49(638)1184)
AD 438559   Unclassified

This report presents an approximate sequential method
of interval estimation suitable for hypothesis test ng in
current research in artificial intelligence, a study of
its properties, and a method of choosing parameter
values to maximize its effectiveness. Relationships
were found between the parameters of the procedure and
its significant properties, including the probabilities
of the two types of error and the expected number of
samples required by the process. Several sets of pa-
rameters were chosen. (Contractor's abstract)

2298

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy,
N. Y.

OXIDATION OF DIETHYLDIBORANE, by W. H. Bauer,

S. E. Wiberley, and E. 1. Sandvik. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-1432) (AF 49(638)-897) AD 622923　　　　Unclassified

Presented at AIAA Heterogeneous Combustion Conf., Palm Beach, Fla., Dec. 11-13, 1963.

Also published in Prog. in Astronaut. and Aeronaut., v. 15: 375-390, 1964.

The gas-phase oxidation of sym-diethyldiborane was studied under both explosive and nonexplosive conditions. With excess oxygen the nonexplosive reaction was a partial oxidation to form ethyl metaborate and hydrogen. The rate of disappearance of sym-diethyldiborane in the partial oxidation was found to be zero order in oxygen and first order in sym-diethyldiborane. The formation of an unstable intermediate in the partial oxidation was observed. The products of explosions with excess oxygen were carbon dioxide, water, and a white solid, B_2O_3. The explosion is believed to be predominantly thermal in nature. The enthalpy change of the partial oxidation has been estimated to be sufficient to initiate complete combustion by the temperature increase caused by energy release on formation of ethyl metaborate and hydrogen.

2299

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

AN INVESTIGATION OF SOME REACTIONS OF ACTIVE NITROGEN, by D. R. Safrany. June 1964, 173p. incl. illus. diagrs. tables, refs. (AFOSR-65-1337) (AF AFOSR-63-174) AD 620226　　　　Unclassified

The reactions of active nitrogen were studied in a fast-flow, low-pressure system using a mass spectrometer whose leak was located directly downstream from the reaction zone. Reactions of metastable $N_2(A^3\Sigma_u^+)$ molecules, produced by means of surface catalyzed excitation, were also investigated. It was shown that $N_2(A^3\Sigma_u^+)$ molecules generally do not play a major role in the reactions of active nitrogen with inorganic and organic substances, e.g., O_2, O_3, N_2O, C_2H_2 and C_2H_4. Contrary to earlier work, it is found that N-atoms reacting with hydrocarbons produce not only HCN, but also N_2 and sometimes NH_3 and CH_3CN as major products. A general degradation mechanism is also proposed involving the attack of the hydrocarbon by a radical other than the N-atom as the initial step.

2300

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

HC1-CATALYZED REACTION OF HYDROCARBONS WITH ACTIVE NITROGEN, by D. R. Safrany, P. Harteck, and R. R. Reeves, Jr. [1964] [2]p. (AF AFOSR-63-174) AD 622850　　　　Unclassified

Also published in Jour. Chem. Phys., v. 41: 1161-1162, Aug. 15, 1964.

The addition of HCl to mixtures of methane, ethane, and other saturated hydrocarbons, with active nitrogen yielded results which serve to emphasize the general importance of hydrocarbon radical reactions in the kinetics of hydrocarbon reactions with active nitrogen.

2301

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

THE IODINE LAMP: A LIGHT SOURCE FOR SELECTIVE EXCITATION OF CO, by P. Harteck, R. R. Reeves, Jr., and B. A. Thompson. [1964] [6]p. (AF AFOSR-63-174) AD 622657　　　　Unclassified

Also published in Zeitschr. Naturforsch., v. 19: 2-6, 1964.

A light source was developed for photochemical studies which emits the 2062 A line of iodine. This lamp was used to study reactions of CO excited in the a3II level. Carbon monoxide was irradiated in an experimental lamp incorporating an arrangement of concentric cylinders. The output of this lamp was 2×10^{18} quanta per sec. The CO a3II molecules react to form CO_2 with a quantum efficiency between a few tenths and unity.

2302

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

THE REACTION OF CH RADICALS WITH AMMONIA, by D. R. Safrany, R. R. Reeves, Jr., and P. Harteck. [1964] [2]p. (AF AFOSR-63-174) AD 622751　　　　Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3160, 1964.

When ammonia was added upstream from an acetylene-nitrogen flame, the ammonia was substantially consumed and hydrogen and hydrogen cyanide were produced (in addition to that expected if the nitrogen were supplied entirely in the form of molecular nitrogen). The following mechanism is proposed for the reaction and supporting evidence is provided: $CH + NH_3 \rightarrow HCN + H_2 + H + 51$ kcal.

2303

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

MOLTEN SALT DATA. ELECTRICAL CONDUCTANCE, DENSITY, AND VISCOSITY, by G. J. Janz, A. T. Ward, and R. D. Reeves. July 1964, 180p. incl. tables, refs. (AFOSR-64-0039) (AF AFOSR-63-181) AD 605938　　　　Unclassified

Conductance, density, and viscosity data at round values of temperature (K) are given for some 126 inorganic compounds as single-salt melts (fluorides, 15; chlorides, 34; bromides, 20; iodides, 23; oxides, 7; sulphates, 5; nitrates, 7; carbonates, 3; and miscellaneous, 12). Equations expressing the temperature dependence of these properties for the single-salt melts are also given. For mixtures of these salts, the binary systems that have received attention are listed; numerical values for these mixtures are not given but are referenced.

2304

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

STRUCTURE AND PROPERTIES OF MOLTEN SALTS, by G. J. Janz. Final rept. Dec. 1964, 10p. incl. refs. (AFOSR-65-0244) (AF AFOSR-63-181) AD 611164   Unclassified

A summary is given of physico-chemical studies which resulted in new insights into the chemical and structural nature of molten inorganic salts. For the purpose of providing a guide to the selection of molten salts for particular applications or structural studies, a classification scheme is proposed (based on the energies of activation) for viscous flow and electrical conductance.

2305

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

MELTING AND PRE-MELTING EFFECTS IN THE ALKALINE EARTH HALIDES, by G. J. Janz, F. J. Kelly and J. L. Perano. [1963] [5]p. incl. diagr. tables, refs. (AFOSR-65-0382) (AF AFOSR-63-181) AD 612227   Unclassified

Also published in Trans. Faraday Soc., v. 59: 2718-2722, Dec. 1963.

Heats and entropies of fusion, and heat content data for $CaBr_2$, $SrCl_2$, $BaCl_2$ and $BaBr_2$, determined by the method of phase-transition drop calorimetry, are reported. Solid-state transitions were confirmed for $SrCl_2$ and $BaCl_2$, and the possible nature and extent of these transitions are examined. An assessment of the phase-transition properties for the alkaline earth halides and nitrates is developed and the results are discussed relative to pre-melting effects and the process of fusion for these salts. For $SrCl_2$, the relatively small value of the melting and pre-melting effects is note-worthy.

2306

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

MELTING AND PRE-MELTING PHENOMENA IN

ALKALI METAL NITRATES, by G. J. Janz, F. J. Kelly, and J. L. Perano. [1964] [4]p. incl. diagr. tables, refs. (AFOSR-65-0383) (AF AFOSR-63-181) AD 611728   Unclassified

Also published in Jour. Chem. and Eng. Data, v. 9: 135-136, Jan. 1964.

Data for the heat content, heats and entropies for the solid-state transition (276°C), and for fusion (307°C), gained by the method of phase-transition drop calorimetry, are reported. The thermal data confirm that the solid-state transition in $NaNO_3$ has unusual features. The change persists from 180° to 280°C, and appears about 60% complete at 270°C. This, and the relatively small magnitude of the thermal effects $\Delta S_{t.}$, 0.32 deg^{-1} mol^{-1}), are examined relative to the nature and extent of the solid-state transition. A comparison of the fusion and pre-fusion parameters for a related series of nitrate and chloride salts is presented and discussed relative to a "premonition of melting" effect as evidenced by such continuous solid-state transition regions. The lower melting point and smaller change in volume on fusion also appear interrelated. (Contractor's abstract)

2307

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

FUSION AND PERFUSION IN SILVER NITRATE, by G. J. Janz and F. J. Kelly. [1963] [3]p. incl. refs. (AFOSR-65-0384) (AF AFOSR-63-181) AD 611729   Unclassified

Also published in Jour. Phys. Chem., v. 67: 2848-2850, Dec. 1963.

The note reports heat capacity data for silver nitrate to bridge the gap between 300 and 438°K, and a reexamination of heat of fusion: The significance and interdependence of the structural changes occurring during the transition and fusion processes in the light of recent crystallographic evidence are briefly considered.

2308

Rensselaer Polytechnic Inst. Dept. of Electrical Engineering, Troy, N. Y.

PHYSICAL PHENOMENA FOR LOGICAL FUNCTIONS, by W. R. Beam. Final technical rept. Feb. 15, 1964 [76]p. incl. diagrs. refs. (AFOSR-64-1379) (AF AFOSR-62-194) AD 604040   Unclassified

There are a number of physical phenomena occurring in solids which have some promise for application to logical devices. Some of these have been partially explored and at least for the present, discarded. Others have received no consideration, not even a feasibility evaluation. The purpose of this work is to consider some of these phenomena to discover in what form and how well they might be used to construct devices and implement useful logical functions. Technical study

areas include: Distributed constant neuristors, niobium oxide negative resistance elements, minimum complexity digital electronics, continuous-medium domain logic and memory devices, and some remarks on topology and power supply of logical networks.

2309

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

ZEROES OF BESSEL FUNCTIONS AND EIGENVALUES OF NON-SELF ADJOINT BOUNDARY VALUE PROBLEMS, by D. S. Cohen. [1964] [7]p. (AFOSR-64-1733) (AF AFOSR-63-182) AD 447598 Unclassified

Also published in Jour. Math. and Phys., v. 43: 133-139, June 1964.

The techniques developed here may be applied equally well to obtain new representation of the solution of the analogous non-self-adjoint boundary value problems in domains interior to cylinders and spheres. These investigations require extensive knowledge of the zeroes of certain linear combinations of Bessel functions and their first derivatives considered as functions of the order of the Bessel function.

2310

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

THE VIBRATIONS OF A RANDOM ELASTIC STRING: THE METHOD OF INTEGRAL EQUATIONS, by B. E. Goodwin and W. E. Boyce. [1964] [6]p. (AFOSR-65-0329) (AF AFOSR-63-182) AD 611995 Unclassified

Also published in Quart. Appl. Math., v. 22: 261-266, Oct. 1964.

The theory of Fredholm integral equations is applied to the problem of determining the natural frequencies of transverse vibrations of a tightly stretched elastic string whose mass per unit length varies with position in a stationary random manner. Upper and lower bounds for the statistical moments of the frequencies are given in terms of corresponding moments and appropriate correlation functions for the random linear density. The adequacy of the bounds decreases for the higher frequencies. Extensions to more general random boundary value problems are also indicated. (Contractor's abstract)

2311

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

RANDOM TRANSVERSE VIBRATIONS OF ELASTIC BEAMS, by W. E. Boyce and B. E. Goodwin. [1964] [17]p. incl. tables. (AFOSR-65-0330) (AF AFOSR-63-182) AD 611901 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 12: 613-629, Sept. 1964.

The problem of analyzing the frequencies of transverse vibrations of random elastic beams is considered. Two types of random elements are admitted: (a) the geometry of the cross-section of the beam may be random; and (b) the support mechanism at one or both ends may be random. In the first case, eigenvalues are studied of the differential equation $\{[1 + R(x)]^4 u''\}'' - \lambda[1 + R(x)]^2 u = 0$, where $R(x)$ is a small stationary perturbation of mean zero. For small $R(x)$, a perturbation expansion is taken about the uniform beam. For the higher modes of vibration, an asymptotic analysis is used. In the second case, eigenvalues are studied for the differential equation $u'''' - \lambda u = 0$. The equation is solved by a perturbation method and by recasting the boundary value problem as a Fredholm equation. Results are in good agreement with those found by more straightforward methods, lending support to the creditability of the procedure used. The methods used can be extended, in principle, to a much larger class of problems than those considered.

2312

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

EQUILIBRIUM POINTS OF BIMATRIX GAMES, by C. E. Lemke and J. T. Howson, Jr. [1964] [11]p. (AFOSR-65-0628) (AF AFOSR-63-339) AD 613870 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 12: 413-423, June 1964.

An algebraic proof is given of the existence of equilibrium points for bimatrix (or two-person, non-zero-sum) games. The proof is constructive, leading to an efficient scheme for computing an equilibrium point. In a nondegenerate case, the number of equilibrium points is finite and odd. The proof is valid for any ordered field.

2313

Republic Aviation Corp. [Plasma Propulsion Lab.] Farmingdale, N. Y.

TERRESTRIAL HYPERSONIC FLIGHT PROPULSION, by K. M. Foreman. 1963, 29p. (AFOSR-J1085) (AF 49(638)552) AD 422930 Unclassified

Presented at AIAA-ASME Conf., Ordnance Lab., hite Oak, Md., Apr. 23-25, 1963.

This preliminary analytical feasibility study examines several new proposed primary chemical propulsion systems, using the terrestrial atmosphere, with particular emphasis on methods of employing electrical augmentation. Specific weight requirements of practical airborne electric power supplies will be indicated for the various types of applications considered. Although the continuous flight corridor is considered appropriate for this study, an additional approximate envelope of

skip-glide trajectories has been included in the potential flight regime because some aspects of electrically augmented systems appear particularly compatible with what would seem the required power plant characteristics of skip-glide operation (i.e., repeatable, high performance, bursts of thrust, of short duration).

2314

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

DIAGNOSTIC STUDIES OF A PINCH PLASMA ACCELERATOR, by D. P. Duclos, L. Aronowitz and others. [1963] [8]p. incl. illus. diagrs. refs. (AF 49(638)552) AD 407769　　　　　　　　　　Unclassified

Presented at the AIAA Electric Propulsion Conf., Colorado Springs, Colo., Mar. 11-13, 1963.

Published in AIAA Jour., v. 1: 2505-2513, Nov. 1963.

Characteristics of a pinch plasma accelerator were investigated by means of measurements of the total discharge current, capacitor voltage, magnetic field distribution and light front velocity. The current distribution and J x B force in the plasma were calculated. The results show that a current sheet resulting from the first half-cycle of current propagates along the electrodes, becoming more diffuse with time. It was observed that there are regions in the sheet where the direction of current density shows local reversals. Magnetic probes indicate that the motion of the current sheet turns from an initially radial to an axial direction and that the magnetic force on the current sheet is essentially in the direction of plasma motion. The impulse produced by J x B forces in the accelerator was computed and was found to be about 80% of the measured thrust. All of the net energy output of the capacitor bank was transferred to the accelerator in the first 2.4 μsec.

2315

Research Triangle Inst., Durham, N. C.

PAIRED-COMPARISON EXPERIMENTS INVOLVING FIVE RESPONSE CLASSES, by W. A. Glenn. Mar. 29, 1963, 21p. incl. tables. (Technical rept. no. 3; Rept. no. SU-74) (AF AFOSR-62-309) AD 416050
　　　　　　　　　　　　　Unclassified

A paired comparison is made by presenting two treatments to a judge who is asked to choose the one that he considers the better on the basis of some common characteristic. A paired-comparison experiment involves the pairwise comparisons of two or more treatments by one or more judges. It is proposed to extend the method of Glenn and David to cover paired-comparison experiments involving five response classes. This will be accomplished by making the assumptions that a tie will occur whenever the difference between the judge's responses to two stimuli under comparison lies below a first threshold, a mild preference will be declared whenever the difference lies between the first threshold and a second threshold, and a strong pref-

erence will be declared when the difference exceeds the second threshold. There will thus be five admissible response classes, viz. the two mild-preference classes, the two strong-preference classes, and the no-preferences (or ties) class.

2316

Research Triangle Inst., Durham, N. C.

ON THE PROBABILITY OF WINNING WITH DIFFERENT TOURNAMENT PROCEDURES, by D. T. Searls. [1963] [18]p. incl. diagrs. tables. (Reprint Series no. S-28) (AFOSR-65-0342) (AF AFOSR-62-309) AD 612206　　　　　　　　　　Unclassified

Also published in Jour. Amer. Stat. Soc., v. 58: 1064-1081, Dec. 1963.

Paired comparisons among competing items are analogous to games between contestants and the process of determining the winning item among t contestants is analogous to a tournament. Four different types of tournaments are investigated for the eight-player case. Expressions are developed for (1) the probability that each player wins and (2) the expected number of games required. Examples are presented for comparison of tournament types and to study the effects of (a) the initial draw, (b) mis-classification when using a priori information in initial pairing, and (c) 'byes.' Some generalizations in terms of number of players and replication are developed.

2317

RIAS, Inc., Baltimore, Md.

STUDY OF NONLINEAR MECHANICS, by S. Lefschetz and J. P. LaSalle. Final rept. Mar. 31, 1958-Mar. 31, 1963. July 11, 1963, 33p. incl. refs. (AFOSR-5130) (AF 49(638)382) AD 413371　　Unclassified

Research results are presented on the following topics: Asymptotic behavior, Functional-differential equations, Stability of dynamical systems, Mathematical theory of control, Qualitative theory of differential equations, and Control theory. Publications for the years 1958-1963 are also listed.

2318

RIAS, Inc., Baltimore, Md.

COBORDISM AND THE EULER NUMBER, by B. L. Reinhart. [1963] [5]p. (AFOSR-J1618) (AF 49(638)-382) AD 427407　　　　　　　　　Unclassified

Also published in Topology, v. 2: 173-177, 1963.

The Euler number is obtained as a cobordism invariant by making a more stringent definition of cobordism, requiring the existence of a non-singular vector field interior normal on one of a pair of cobording manifolds and exterior normal on the other. The new cobordism groups admit natural-homomorphisms into the usual

ones having as kernels cyclic groups generated by spheres. In even dimensions, these kernels are free cyclic and give the Euler number as an additional invariant. In odd dimensions, the kernels are zero except in oriented cobordism of dimension $4k + 1$, where the kernel is cyclic of order 2. In this case, two manifolds are cobordant if and only if they have the same Stiefel-Whitney numbers and bound a manifold of even Euler number. In the oriented case, the kernel is a direct summand, while in the nonoriented case, the even dimensional real projective spaces become of infinite order.

2319

RIAS, Inc., Baltimore, Md.

LINEAR FUNCTIONAL-DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS, by J. K. Hale. [1963] [27]p. incl. refs. (AFOSR-64-0716) (AF 49-(638)382) AD 436508   Unclassified

Also published in Contributions to Differential Equations, v. 2: 291-317, 1963.

This paper is an attempt to obtain some analogies between linear differential-difference equations with constant coefficients and ordinary linear differential equations with constant coefficients. The eigenspaces of the linear equation are discussed in detail and use is made of the adjoint equation to introduce new coordinates in the function space which exhibit in a natural manner the behavior of the solutions on a complementary space. In this manner, it is shown how many of the usual perturbation theorems in ordinary differential can be easily extended to differential-difference equations.

2320

RIAS, Inc., Baltimore, Md.

DYNAMICAL POLYSYSTEMS AND OPTIMIZATION, by D. Bushaw. [1963] [15]p. (AFOSR-64-0717) (AF 49-(638)382) AD 436509   Unclassified

Also published in Contributions to Differential Equations, v. 2: 351-385, 1963.

The elements of a new general formalism is described which seems to hold promise as a device for the analysis of dynamical systems with alternative inputs, much as the now well-established subject of topological dynamics. Basic definitions and a few fundamental facts are presented. Attention is concentrated on optimization problems and the closely related question of the structure of the boundary of the so-called reachable sets. This line of inquiry culminates in the generalized Jacobi condition and its corollary. Mention is made of the potentially interesting and useful aspects of the theory of dynamical polysystems.

2321

RIAS, Inc., Baltimore, Md.

PHOTOOXIDATION OF CYTOCHROMES C, F, AND PLASTOCYANIN BY DETERGENT TREATED CHLOROPLASTS, by B. Kok, H. J. Rurainski, and E. A. Harmon. [1964] [8]p. (AFOSR-64-1839) (AF 49(638)947) AD 449972   Unclassified

Also published in Plant Physiol., v. 39: 513-520, July 1964.

An analysis was made of the long wavelength sensitized photooxidation by detergent treated spinach chloroplasts of ferrocytochrome c, ferrocytochrome f, and cupro plastocyanin. All systems were stimulated (up to sixfold) by viologen dyes and other autooxidizable low potential, single electron transfer agents. In the presence of viologen, the photooxidation of ferrocytochrome c was stimulated by catalytic amounts of cytochrome f and plastocyanin. These agents respectively stimulated up to 30- and 150-fold and sustained rates up to 1500 and 5000 μ mol/mg chlorophyll hour. In all cases, the quantum yield as well as the light saturated rate was enhanced.

2322

RIAS, Inc., Baltimore, Md.

LIFE SUPPORT SYSTEMS FOR SPACE MISSIONS, by L. Bongers and B. Kok. [1964] [13]p. (AFOSR-64-1840) (AF 49(838)947) AD 449970   Unclassified

Also published in Develop. Indus. Microbiol., v. 5: 183-195, 1964.

A comparative survey is presented of regenerative, partially regenerative, and nonregenerative life support systems. Attention is focused on methods for controlling atmospheric gases and providing food in sealed environments occupied by a crew. Mission requirements strongly influence the control methods which will be employed in the preceding environments. Also, mission time especially influences this selection. As an example, for a mission of short duration, the storage of oxygen, food and water and the disposal of metabolic waste products is the obvious method. However, with an extension of mission time, chemical regeneration will partially displace the simple storage techniques. Specifically, reclamation is indicated of both the waste water and some of the oxygen bound in carbon dioxide. A further increase in mission time and crew size may make food storage uneconomical and would require the recycling of almost all metabolic products. Presently, it seems unlikely that complete regeneration of carbon dioxide and waste products can be accomplished by other than biological means. Therefore, biosynthesis provides the only method of regeneration for missions lasting longer than several months.

2323

RIAS, Inc., Baltimore, Md.

TWO LIGHT REACTIONS IN PHOTOSYNTHESIS, by

G. E. Hoch. [1964] [15]p. incl. diagrs. tabie.
(AFOSR-64-2152) (AF 49(638)947) AD 450888
Unclassified

Also published in Record Chem. Prog., v. 25: 165-180,
Sept. 1964.

Research in photosynthesis is currently undergoing an
exciting resurgence of interest. This increase in in-
terest has been brought about principally by the dis-
covery that two light reactions are required for aerobic
photosynthesis (those plants and organisms in which
molecular oxygen is evolved). In this article an at-
tempt is made to describe the present status of our
knowledge on the nature of the two photoreactions, how
they cooperate, and how the plant controls the energy
flux into the two reactions.

2324

RIAS, Inc., Baltimore, Md.

RESEARCH ON CONTROL SYSTEMS, by R. E. Kalman.
Final rept. Nov. 15, 1962-Sept. 30, 1964, 14p.
(AFOSR-64-1788) (AF 49(638)1206) AD 607567
Unclassified

The following areas were studied. (1) Stability theory,
(2) optimal control and calculus of variations, (3)
stochastic variational problems, (4) stochastic optimal
filters, (5) finite automata and related topics, (6) ap-
plied mathematics and digital computation. The main
research effort was in the area of stochastic optimiza-
tion problems. Considerable progress was achieved,
both in the realm of stochastic optimal control and
stochastic optimal control and stochastic optimal fil-
tering. A second area of concentration has been the
theory of automata. This may be regarded as the alge-
braic part of control theory, in contrast to the preced-
ing predominately analytical investigations. Much use-
ful work has been accomplished in reconciling automata
theory and control theory; much more remains to be
done.

2325

RIAS, Inc., Baltimore, Md.

WEIGHTING PATTERNS AND THE CONTROLLABILITY
AND OBSERVABILITY OF LINEAR SYSTEMS, by L.
Weiss. [1964] [6]p. (AF 49(638)1206) AD 448382
Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 51:
1122-1127, June 1964.

The purpose of this paper is twofold. First, a general-
ization is presented of Kalman's result which consists
of the fact that there are actually four possible decom-
positions of the state space of a linear dynamical sys-
tem. Second, the relationship of internal to external
system characteristics is discussed. Specifically, a
table is given which correlates certain properties of a
system's weighting pattern with a certain property of
the system's various state space decompositions.

2326

RIAS, Inc., Baltimore, Md.

PION-PION SCATTERING IN THE STRIP APPROXI-
MATION - I, by B. H. Bransden, P. G. Burke and
others. [1963] [23]p. (AFOSR-64-0364) (AF 49(638)-
1211) AD 434521 Unclassified

Also published in Nuovo Cimento v. 30: 207-229, Oct.
1, 1963.

Results are presented of calculations on pion-pion scat-
tering in the strip approximation. A cut-off is made to
avoid divergences at high energy. The starting point
is an assumed form for the low partial wave based on
experiment, supplemented by partial wave solutions of
the pion-pion problem. The spectral functions are cal-
culated and two sets of predictions are made. Firstly,
higher elastic partial waves, in particular the D-waves,
are evaluated, as are also the low-energy inelastic
partial waves. These predictions are relatively insen-
sitive to the cut-off. Secondly, Regge trajectories are
deduced from the asymptotic behavior of the spectral
functions.

2327

RIAS, Inc., Baltimore, Md.

GROWTH OF SINGLE CRYSTALS OF SILVER IN THE
PRESENCE OF FINELY DIVIDED ALUMINA, by H. R.
Peiffer and R. Gockle. Sept. 1963, 16p. (Technical
note no. 1) (AF 49(638)1217) AD 425965
Unclassified

The silver phase of silver and finely divided alumina
composites is shown to grow as single crystals upon
solidification from the melt. These crystals grow
without the aid of an externally applied thermal gradi-
ent or a mold. The single crystal growth is more
readily disrupted as the alumina content varies from
the optimum concentration of twenty weight percent.
Pretreatment such as variation of fabrication pressure,
and presintering of the specimens appears to play a
lesser role in this phenomenon.

2328

RIAS, Inc., Baltimore, Md.

LCAO-MO CALCULATIONS ON BORON COMPOUNDS.
I. AMINOBORANES, by J. J. Kaufman and J. R.
Hamann. [1963] [5]p. (AFOSR-64-2010) (AF 49(638)-
1220) AD 451194 Unclassified

Also published in Advan. Chem. Ser., 1963, p. 95-99.

The primary purpose of this study was to reproduce
reported experimental observations for a series of
heteroatomic boron compounds by simple LCAO-MO
Huckel calculations, employing as input data only basic
atomic or group parameters derived without reference
to the particular molecular environments considered
here. Huckel calculations for aminoboranes (using the
four possible input parameter sets derivable from other

molecules) were compared, point by point, with experimental observations of seven aspects of the behavior of aminoboranes upon substitution. Each experimental observation was correctly predicted. More important, the trend of the calculational results is insensitive to the choice among the input parameter sets.

2329

RIAS, Inc., Baltimore, Md.

LCAO-MO CALCULATIONS ON BORON COMPOUNDS. II. BORAZINES, by O. Chalvet, R. Daudel and J. J. Kaufman. [1963] [9]p. (AFOSR-64-2011) (AF 49(638)-1220) AD 451193   Unclassified

Also published in Advan. Chem. Ser., v. 24: 251-258, 1963.

Molecular orbital calculations for borazines using an LCAO technique have been performed in the framework of the following approximations: Huckel, Pariser-Parr (without iteration), and Pople (iterated to self-consistency utilizing the Pariser-Parr approximations for the integrals). Several theoretical models for choice of input parameters have been utilized. Modified values for boron electron-repulsion integrals, which take into account electron correlation effects, have been calculated for each choice of theoretical model.

2330

RIAS, Inc., Baltimore, Md.

LCAO-MO CALCULATIONS ON BORON COMPOUNDS. III. HETEROAROMATIC BORON COMPOUNDS, by J. J. Kaufman and J. R. Hamann. [1963] [8]p. incl. tables. (AFOSR-64-2012) (AF 49(638)1220) AD 451192   Unclassified

Also published in Advan. Chem. Ser., v. 27: 273-280, 1963.

Molecular orbitals for the π-systems of aromatic hydrocarbons, where a B-N pair replaces a C-C pair, have been calculated, using an LCAO technique with the Huckel, Pariser-Parr, and Pople approximations. Several theoretical models were used to choose input parameters, and modified values for boron electron-repulsion integrals were calculated, taking into account electron correlation effects. Complete LCAO-MO-SCF calculations were performed for each choice of input parameters. (Contractor's abstract in part)

2331

RIAS, Inc., Baltimore, Md.

THE EFFECT OF SUBSTITUTION ON THE IONIZATION POTENTIALS OF FREE RADICALS AND MOLECULES. VII. THEORETICAL RATIONALIZATION FOR DIFFERING CORRELATIONS FOUND FOR BOND DISSOCIATION ENERGIES WITH IONIZATION POTENTIALS AND ELECTRON AFFINITIES OF ORGANIC OR

INORGANIC RADICALS, by J. J. Kaufman. [1964] [3]p. (AFOSR-65-0570) (AF 49(638)1220) AD 613922   Unclassified

Also published in Jour. Phys. Chem., v. 68: 3155-3157, Nov. 1964.

The discrepancy previously noted in the relations of bond dissociation energies into organic radicals or inorganic radicals has been explained on both semi-empirical and theoretical grounds. Earlier research on δ_K values showed that it was possible to place electronegativities, χ, of organic radicals correctly in the experimentally observed order solely on the basis of their ionization potentials. Since $\chi \sim (1 + E)/2$, this dependence of χ on I alone indicated that E was small relative to l and/or varied comparatively little for a series of organic radicals. On the contrary, E for a series of inorganic radicals will vary over a much wider range when the central atom is as diverse as N, O, F, Cl, or Br. A theoretical rationalization based on Mulliken's formulas gives further confirmation to the justification for the differing relationship between dissociation energies and ionization potentials or ionization potentials minus electron affinities for organic and inorganic radicals. (Contractor's abstract)

2332

RIAS, Inc., Baltimore, Md.

LCAO-MO-SCF CALCULATIONS OF C_6O_6 SYSTEMS, by J. J. Kaufman. June 1964 [38]p. incl. tables, refs. (Technical rept. no. 64-11) (AFOSR-65-0571) (AF 49-(638)1220)   Unclassified

Also published in Jour. Phys. Chem., v. 68: 2648-2651, Sept. 1964.

Simple Huckel MO calculations by West predicted a biradical nature for $C_6O_6^{-1}$, due to the degeneracy of molecular orbitals $\varphi 8$ and $\varphi 9$, while experiments showed $C_6O_6^{-4}$ to be diamagnetic. To test the sensitivity of the prediction to MO calculational methods, Pariser-Parr and Pople SCF calculations were performed for C_6O_6, $C_6O_6^{-2}$, and $C_6O_6^{-4}$. Evaluating the configuration interaction matrix elements utilizing the integral values for a Pople SCF calculation of neutral C_6O_6 or $C_6O_6^{-2}$ indicates that electron interaction terms alone do not seem to be sufficient to make the singlet state be lower in energy than the triplet state. The calculational results indicate that for charged species it is not sufficient to use integral values derived from the neutral species, since this leads to physically unmeaningful results for the absolute energies of the species. It is suggested that the splitting of the degeneracy may possibly be due to a type of Jahn-Teller effect-which, however, must necessarily be weak since the electrons involved do not participate strongly in the binding of the molecule. (Contractor's abstract, modified)

2333

RIAS, Inc., Baltimore, Md.

MOLECULAR VIBRATIONS BY A MATRIX FORCE
METHOD, by S. Kaufman, D. B. Hall, and J. J.
Kaufman. Sept. 1964 [19]p. incl. diagrs. table.
(Technical rept. no. 64-16) (AFOSR-65-1803)
(AF 49(638)1220) AD 625874   Unclassified

The molecular vibrations of complex molecules are
calculated from previously derived force constants by
means of a matrix force method. The purpose of the
investigation is to ascertain the utility of an existing
large IBM 7094 digital program, based on a matrix
force method, for making these calculations. The fre-
quencies and normal vibrational modes of the molecule
ethylene are computed and compared against experi-
mental and calculated results. From the agreement of
the results, it is concluded that the computer program
can be successfully used not only in this instance in
which a valence force field approximation is used, but
also with any force field approximation and for handling
extremely large problems.

2334

RIAS, Inc., Baltimore, Md.

A STABILITY THEOREM FOR FUNCTIONAL-DIFFER-
ENTIAL EQUATIONS, by J. K. Hale. [1963] [5]p.
(AFOSR-64-0732) (AF 49(638)1242) AD 436514
                              Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 50:
942-946, Nov. 1963.

The term functional-differential equation as used in
this paper is a natural generalization of the concept
of a differential equation with delayed arguments.
The natural setting for a discussion of such equations
seems to be in the space C of continuous functions over
a finite interval. For ordinary differential equations,
the limiting sets of bounded trajectories are contained
in the largest invariant set contained in the set where
the derivative of a Lyapunov function V vanishes, pro-
vided only that V is bounded below and the set where
V is less than a constant is bounded. It is the purpose
of the present note to extend this result to functional-
differential equations.

2335

RIAS, Inc., Baltimore, Md.

ON A SYSTEM OF EQUATIONS IN AUTOMATIC CON-
TROL THEORY, by K. R. Meyer. [1964] [11]p.
(AFOSR-64-1619) (AF 49(636)1242) AD 449259
                              Unclassified

Also published in Contributions to Differential Equa-
tions, v. 3: 13-173, 1964.

Letov has introduced the study of a control system in
which the equations of the control take into account
the applied load. In particular he has taken an equa-
tion of Khokhlov that describes a loaded hydraulic

servomotor and used this to describe the action of the
automatic roll stabilization system in the Queen Mary.
In this paper the system introduced by Letov is ex-
amined with the aid of a lemma due to Yacubovich as
generalized by Kalman. A rather complete answer can
be given for the noncritical case as well as for some
critical cases.

2336

RIAS, Inc., Baltimore, Md.

A REMARK ON A RESULT OF LEFSCHETZ, by K. R.
Meyer. [1964] [3]p. (AFOSR-65-0319) (AF 49(636)-
1242) AD 612456   Unclassified

Also published in Contributions to Differential Equations,
v. 3: 435-437, 1964.

A condition for absolute stability as presented by
Lefschetz considered a system (1) $x = Ax + b\varphi(\sigma)$, $\sigma =$
$c'x$; and Liapunov function (2) $V = x'Bx + \int_0^\sigma \varphi(\sigma)d\sigma$ whose
derivative along the trajectories of (1) is (a) $-\dot{V} = 2(Bx +$
$\varphi(\sigma)c)'(Ax + b\varphi)$ and (b) $-\dot{V} = x'Cx - \frac{1}{2}(Bb + 1/2\ A'c)'$
$x\varphi(\sigma) - c'b\ \varphi^2(\sigma)$. If $-V$ is positive definite, then (1) is
absolutely stable. In this report an alternate procedure
is presented for making $-\dot{V}$ positive definite. The fol-
lowing two conditions are shown to suffice: (a) the sys-
tem of equations $Ax + b\varphi(c'x) = 0$ has only the solution
$x = 0$ for all admissible φ or $c'A^{-1}b \geq 0$ and (b) for some
positive definite C, $c'b - (Bb + 1/2\ A'c)'C^{-1}(Bb +$
$1/2\ A'c) = 0$.

2337

RIAS, Inc., Baltimore, Md.

ON THE PARAMETRIZATION OF THE THREE-DI-
MENSIONAL ROTATION GROUP, by J. Stuelpnagel.
[1964] [6]p. (AFOSR-65-0616) (AF 49(636)1242)
AD 614675   Unclassified

Also published in SIAM Rev., v. 6: 422-430, Oct. 1964.

In this paper it is shown why it is topologically impos-
sible to have a global 3-dimensional parametrization
without singular points for the rotation group. This is
a special case of a corollary to Brouwer's theorem on
the invariance of domain. It is also pointed out that,
although Hopf showed in 1940 that five is the minimum
number of parameters which suffices to represent the
rotation group in a 1-1 global manner, the so-called
"quaternion method" of parametrizing the group in a
1-2 way, using 4 parameters, is sufficient for practi-
cal purposes. In addition, three 3-dimensional para-
metrizations, as well as Hopf's method of using 5
parameters, are examined.

2338

RIAS, Inc., Baltimore, Md.

GENERALIZED RECURRENCE IN DYNAMICAL

SYSTEMS, by J. Auslander. [1964] [6]p. (AFOSR-65-2321) (AF 19(636)1242) AD 829269   Unclassified

Also published in Contributions to Differential Equations, v. 3: 65-74, 1964.

In this paper, a notion of recurrence in dynamical systems is introduced which is defined using continuous real valued functions on the phase space. The basic idea is as follows: Consider the class of continuous real valued functions which are nonincreasing along every orbit; then, single out those orbits along which all such functions are constant. This set, which includes the periodic, recurrent, and non-wandering points, is called the generalized recurrent set. Its elementary properties are studied and it is shown that a single suitably chosen function reflects the 'recursive' behavior of the dynamical system. By means of prolongations, an intrinsic characterization of the generalized recurrent set is given. This depends on a purely topological result involving a closed quasi order which is apparently new and may be of independent interest. The connection of the generalized recurrent set with asymptotic and absolute stability of a compact invariant set is discussed. The condition that the dynamical system be free of generalized recurrent orbits is shown to lie between parallelizability and complete instability.

2339

Rice U. [Dept. of Mathematics] Houston, Tex.

THREE CIRCLE THEOREMS IN PARTIAL DIFFEREN-TIAL EQUATIONS AND APPLICATIONS TO IM-PROPERLY POSED PROBLEMS, by K. Miller and J. Serrin. [1964] [29]p. (AFOSR-64-1591) (AF AFOSR-62-233) AD 448533   Unclassified

Also published in Arch. Rational Mech. and Anal., v. 16: 126-154, 1984.

In this paper analogous three circle theorems are found for harmonic functions on a disc, but with respect to L2 or even weaker bounds on the inner and outer circles. In fact, it is sufficient that the function correspond to a Schwartz distribution of finite order on the outer circle. Analogous three line theorems are found for periodic solutions of the heat equation and for periodic solutions of the Cauchy problem for Laplace's equation. In the process, a very general and flexible method is presented for finding uniform bounds on the solution and its derivatives in terms of L2 bounds on the data. Moreover, these bounds are, except for a factor of a most two, best possible. The method involves reduction of the problem to a consideration of the Fourier coefficients of the solutions and maximization of linear functionals of the coefficients with respect to quadratic constraints.

2340

Rice U. [Dept. of Mathematics] Houston, Tex.

ON THE ADJOINT OF A CLOSED TRANSFORMATION, by A. Brown. [1964] [2]p. (AFOSR-64-1592) (AF AFOSR-62-234) AD 446534   Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 239-240, Apr. 1964.

The main purpose of this note is to give a new proof of a known theorem. The basic "alternative" relations between an operator and its adjoint, on which Theorem 2 represents one possible formulation, are well known for bounded operators and offer no difficulty for closed operators if the spaces are reflective.

2341

Rochester U. [Dept. of Chemistry] N. Y.

PHOTOLYSIS OF BIACETYL-OXYGEN MIXTURES AT 4358 ANGSTROMS, by N. Padnos and W. A. Noyes, Jr. [1964] [5]p. (AFOSR-84-1803) (AF 49(838)679) AD 449064   Unclassified

Also published in Jour. Phys. Chem., v. 88: 484-466, 1964.

The photolysis of gaseous mixtures of biacetyl (2,3-butanedione) and 0.02-2.0 mm of oxygen by light of 4356 A has been studied. Carbon monoxide, carbon dioxide, water, methanol, and formaldehyde were found as products. The variation of carbon dioxide yields and oxygen consumption with oxygen pressure is similar to that which would be predicted if the only effect of oxygen pressure were on the ratio of triplet biacetyl deactivated in first-order processes to that reacting bimolecularly with oxygen.

2342

Rochester U. Dept. of Chemistry, N. Y.

INTERNATIONAL SYMPOSIUM ON PHOTOCHEMISTRY, by D. J. Wilson. Aug. 28, 1963, 88p. (AFOSR-J1095) (AF AFOSR-83-184) AD 436086
    Unclassified

The international symposium on photochemistry was held at Rochester U. on Mar. 27-29, 1963. The event was supported by the Air Force Office of Scientific Research, the University of Rochester, the eastman Kodak Co., the Xerox Corp., and Will Scientific. Seventy-five papers covering practically all aspects of photochemistry were presented.

2343

Rochester U. Dept. of Chemistry, N. Y.

THE PRIMARY PHOTOCHEMICAL PROCESS IN COMPLEX MOLECULES AND THE REACTIONS OF CERTAIN RADICALS, by W. A. Noyes, Jr. Final rept. Feb. 1, 1963-Aug. 1, 1964, 7p. (AFOSR-64-1686) (AF AFOSR-63-206) AD 616075   Unclassified

Work in the following areas is summarized: behavior of excited singlet and triplet states of several molecules; reactions of triplet states; photochemistry of certain molecules including reactions of radicals. A bibliography of papers published under the grant is given.

2344

[Rochester U. Dept. of Chemistry, N. Y.]

ENERGY DISSIPATION FROM EXCITED STATES OF POLYATOMIC MOLECULES, by W. A. Noyes, Jr. 1964, 22p. incl. refs. (AFOSR-64-2433) (AF AFOSR-63-206)   Unclassified

The knowledge of the excited states from which the emission of radiation proceeds, is of fundamental importance for the study of the kinetics of energy dissipation absorbed by molecules. Having postulated mechanisms of energy dissipation for polyatomic molecules (e.g. benzene, biacetyl and acetone) based on the existence of excited states of different multiplicities of spin, the existing, experimental results, in spite of being scarce, seem to confirm the proposed hypotheses. Finally, forecasts are made on the behavior of the cetene molecule that, when subject to radiations of different wavelengths, originates the radicals CH_2 in excited states with different multiplicities of spin. (Contractor's abstract)

2345

Rochester U. [Dept. of Mechanical and Aerospace Science] N. Y.

PRECURSORS AHEAD OF PRESSURE DRIVEN SHOCK WAVES IN ARGON, by H. D. Weymann and L. B. Holmes. [1963] [5]p. (AFOSR-64-1021) (AF AFOSR-64-478) AD 440977   Unclassified

Also published in Compt. Rend. VIe Conf. Internat'l. sur le Phenomenes d'Ionisation dans les Gaz, Paris (France), v. 4: 261-265, 1963.

Processes that can create electrons ahead of strong shock waves are: photoionization of the gas, photoemission from the shock tube walls, and diffusion from the plasma behind the shock front. Using a glass shock tube and electrostatic probes outside the tube it was possible to distinguish between the precursors generated by these three processes. Experiments on light absorption and the influence of an axial magnetic field supplemented the electrostatic measurements.

2346

Rochester U. Dept. of Physics and Astronomy, N. Y.

NUCLEAR INTERACTIONS OF 900 MEV ALPHA PARTICLES, by M. V. K. Appa Rao and P. J. Lavakare. June 5, 1963 [13]p. incl. diagrs. (Rept. no. NYO-10269) (AFOSR-5055) (AF AFOSR-62-32)   Unclassified

The nuclear interactions of 900 mev He^4 nuclei in nuclear emulsion are studied. The mean free path for interaction is found to be 17.0 ± 0.6 cm. This value together with values obtained at various energies shows that the mean free path for nuclear interaction of He^4-nuclei in nuclear emulsion is energy independent. The "in-out" interaction has been studied and

the probability, f_{io}, for such an interaction is found to be $12.2 \pm 1.6\%$. (Contractor's abstract)

2347

Rochester U. Dept. of Physics and Astronomy, N. Y.

AN INVESTIGATION ON THE MULTIPLE COULOMB SCATTERING IN NUCLEAR RESEARCH EMULSIONS, by C. Dahanayake and P. J. Lavakare. June 12, 1963 [20]p. incl. diagr. tables. (Rept. no. NYO-10271) (AFOSR-5056) (AF AFOSR-62-32)   Unclassified

A stack of Kodak emulsions, exposed to 6.2 bev proton beam, has been used to study the behavior of spurious scattering in these emulsions. The effect of higher order differences has also been considered. A detailed study of the behavior of the scattering constant as a function of cell length is also presented. The results indicate the necessity for a slight modification in the theory of multiple coulomb scattering. (Contractor's abstract)

2348

Rochester U. Dept. of Physics and Astronomy, N. Y.

ON THE MODULATION OF COSMIC RAY NUCLEI WITH Z > 2 DURING THEIR PROPAGATION, by M. V. K. Appa Rao. [1963] [13]p. incl. diagr. table. (AFOSR-5263) (AF AFOSR-62-32)   Unclassified

The effect of spallation and ionization loss on the relative abundances and energy spectra of cosmic ray nuclei of charge greater than two, during their propagation in the interstellar and interplanetary space, has been determined. Comparison of the results with experimental observations indicate that cosmic ray nuclei travel an amount of interstellar hydrogen proportional to $(\epsilon^2-1)^{-x}$, (where ϵ is the total energy of the nuclei in terms of their rest mass) with x between 0.16 and 0.25 and with the high energy nuclei ($\epsilon = 4$) traversing 2 to 2.5 gms/cm^2 of interstellar hydrogen. (Contractor's abstract)

2349

Rochester U. Dept. of Physics and Astronomy, N. Y.

HIGH ENERGY p-p AND π-p SCATTERING IN SERBER'S MODEL, by H. H. Aly, D. Lurie, and S. Rosendorff. [1963] [3]p. incl. diagrs. table, refs. (AFOSR-64-0508) (AF AFOSR-62-32) AD 436169   Unclassified

Also published in Phys. Ltrs., v. 7: 198-199, Nov. 15, 1963.

In a recent paper by Serber, a fit to the high energy p-p scattering data was attempted using an optical model for a purely imaginary Yukawa potential of the form $V(r) = i\eta \dfrac{e^{-\Lambda r}}{r}$ In this note we shall first

compare the predictions of this model with the experimental high energy data for $\pi^{\pm}$-p scattering. We shall then investigate the question of whether a more complicated potent'.i as suggested by Serber, namely a superposition of two Yukawa potentials of the form

$$V(r) = i\eta_1 \frac{e^{-\Lambda r}}{r} + i\eta_2 \frac{e^{-\beta\Lambda r}}{r} \quad \text{can emprove}$$

the agreement. (Contractor's absi:'act)

2350

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ON THE PEKAR AND PERLIN CALCULATION OF F-CENTER LIFETIMES, by W. I. Fowler and D. L. Dexter. [1963] [3]p. (AFOSR-J1561) (AF AFOSR-62-145) AD 427655   Unclassified

Also published in Phys. Stat. Sol., v. 3: 1865-1867, 1963.

In a recent paper Pekar and Perlin presented a calculation, based upon Pekar's continuum theory of the F-center, of the radiative lifetime of the first excited level of the F-center. Their results are in order-of-magnitude agreement with the experimental results of Swank and Brown. It is suggested that such agreement is fortuitous and is the result of several invalid assumptions made by Pekar and Perlin: (1) they have neglected to include an effective field correction in their calculation; (2) they have used the same electronic wave functions to calculate emission probabilities as one would use (in Pekar's theory) to calculate absorption probabilities, a procedure which we have shown to be susceptible to suspicion; and (3) these electronic wave functions are in fact not consistent with observed absorption oscillator strengths. (Contractor's abstract)

2351

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ELECTRONIC BAND STRUCTURE AND WANNIER EXCITON STATES IN SOLID KRYPTON, by W. B. Fowler. [1963] [9]p. (AFOSR-64-0455) (AF AFOSR-62-145) AD 435917   Unclassified

Also published in Phys. Rev., v. 132: 1591-1599, Nov. 1963.

The electronic band structure of solid krypton has been calculated by a combined tight-binding and orthogonalized plane wave approach first introduced by Knox and Bassani. The crystal potential, constructed as a sum of quasiatomic potentials, contains an exchange potential which has been made to approximate closely the crystal Slater exchange potential. Spin-orbit splittings have been computed, and effective masses have been obtained at points of high symmetry in the Brillouin zone. The smallest computed gap between valence and conduction bands is direct, and has a magnitude of 11.3 ev, in agreement with the direct gap of 11.8 ev inferred by Baldini on the basis of optical absorption data.

2352

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ORIENTATION OF THE M-CENTER, by D. L. Dexter. [1964] [4]p. (AFOSR-64-1258) (AF AFOSR-62-145) AD 442804   Unclassified

Also published in Phys. Stat. Sol., v. 4: 601-604, 1964.

A discussion is given and experiments are suggested regarding the polarization and reorientation of M-centers by optical excitation, with reference to the electron-lattice interaction in ionic crystals.

2353

Rochester U. [Dept. of Physics and Astronomy] N. Y.

OPTICAL PROPERTIES OF THE NOBLE METALS, by M. Suffczynski. [1964] [27]p. (AFOSR-64-1771) (AF AFOSR-62-145) AD 450556   Unclassified

Also published in Phys. Stat. Sol., v. 4: 3-29, 1964.

The theory of the optical properties of metals is based on the conception of free electrons at low energies of incident photons, say below 1eV. In this region the modification of the incident electric field near the metal surface and the collisions of the electrons with this surface are described by the theories of skin effect and anomalous skin effect. Between 0.1 to 1ev the classical Drude theory is most useful. Above a threshold, which for copper and gold lies in the middle of the visible range of the spectrum, interband transitions occur from occupies to unoccupied bands. Additive contributions of the effects of the free and bound electrons give rise to a variety of plasma resonances. At higher photon energies transitions from the deep core levels occur, and finally, at about 50 ev, the typical x-ray region is reached.

2354

Rochester U. [Dept. of Physics and Astronomy] N. Y.

OPTICAL EROSION, by D. L. Dexter. [1964] [13]p. (AFOSR-64-1772) (AF AFOSR-62-145) AD 449254   Unclassified

Also published in Nuovo Cimento, Seriex X, v. 32: 90-102, Apr. 10, 1964.

A review is presented of some of the facts and ideas related .. possible erosive action of light on condensed .. Various mechanisms are described which would be expected to lead to erosion. These include bond-breaking, a toionization, indirect, phonon-assisted processes, local heating phenomena, etc. Some special cases are mentioned in which photo-disintegration has been observed, although these examples are not true erosion in the sense intended here. Areas of possible importance of this effect are mentioned, large ignorance of its efficiency is exposed, and pertinent experiments are suggested.

2355

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ATOMIC MULTIPOLE INTERACTIONS IN RARE-GAS
CRYSTALS, by R. S. Knox and M. H. Reilly. [1964]
[5]p. (AFOSR-64-2109) (AF AFOSR-62-145)
AD 451731   Unclassified

Also published in Phys. Rev., v. 135: A166-A170,
July 6, 1964.

It is demonstrated that one of the mechanisms seriously
proposed to explain the relative stability of rare-gas
solids in the cubic form, namely greater repulsion be-
tween induced electrical multipoles in the hexagonal
form, is completely ineffective. The present status
of the stability problem is briefly discussed.

2356

Rochester U. [Dept. of Physics and Astronomy] N. Y.

THEORY OF THE OPTICAL AND MAGNETIC PROPER-
TIES OF THE SELF-TRAPPED HOLE IN LITHIUM
FLUORIDE, by T. P. Das, A. N. Jette, and R. S.
Knox. [1964] [15]p. (AFOSR-64-2110) (AF AFOSR-
62-145) AD 451348   Unclassified

Also published in Phys. Rev., v. 134: A1079-A1093,
May 18, 1964.

Using a semiphenomenological method, the energy and
wave functions of a self-trapped hole (V_k center) in
LiF are obtained as a function of the separation be-
tween the two F-ions at which the hole is assumed
trapped. Only the energy curve for the ground state
exhibits a minimum in the expected region of F-ion
separation. From the resulting configurational coordi-
nate curves, the optical absorption energy and width
are computed and are in order-of-magnitude agreement
with experiment. Computed values of the experimen-
tally known isotropic and anisotropic hyperfine con-
stants are used to access the validity of our molecular
wave functions.

2357

Rochester U. [Dept. of Physics and Astronomy] N. Y.

THE FRESNEL FIELD IN KOTTLER'S DIFFRACTION
THEORY, by B. Karczewski. [1963] [6]p. (AFOSR-
64-0053) (AF AFOSR-62-246) AD 431139
                                           Unclassified

Also published in Canad. Jour. Phys., v. 41: 1623-
1628, 1963.

The Kottler theory of electromagnetic diffraction has
been shown to be in good agreement near the boundary
of geometrical shadow with the Kirchoff scalar approach.

2358

Rochester U. [Dept. of Physics and Astronomy] N. Y.

COHERENCE THEORY OF THE ELECTROMAGNETIC
FIELD, by B. Karczewski. [1963] [10]p. (AFOSR-64-
0814) (AF AFOSR-63-237) AD 438379   Unclassified

Also published in Nuovo Cimento, Series X, v. 30:
906-915, Nov. 10, 1963.

Up to now the degree of coherence of a wave field was
only defined on the basis of a scalar wave theory. In
the present paper a generalization is proposed applica-
ble to any quasimonochromatic stationary electromag-
netic field. The electromagnetic degree of coherence,
which is a single scalar quantity, is introduced from
the analysis of an interference experiment and it is
shown to be related to the trace of the correlation ten-
sor of the electric field introduced by E. Wolf in 1954.

2359

Rochester U. [Dept. of Physics and Astronomy] N. Y.

COHERENCE PROPERTIES OF BLACKBODY RADIA-
TION. I. CORRELATION TENSORS OF THE CLASSI-
CAL FIELD. II. CORRELATION TENSORS OF THE
QUANTIZED FIELD, by C. L. Mehta and E. Wolf.
[1964] [11]p. (AFOSR-64-1919) (AF AFOSR-63-237)
AD 450516   Unclassified

Also published in Phys. Rev., v. 134: A1143-A1153,
June 1, 1964.

This paper is concerned with the extensions of some re-
cently reported results, especially those of Bourret
(1960), relating to coherence properties of blackbody
radiation. An explicit expression for the complex elec-
tric correlation tensor of blackbody radiation is derived,
and on the basis of it spatial coherence is discussed in
detail. The behavior of diagonal as well as nondiagonal
components is illustrated by contour diagrams. In par-
ticular, it is found that the nondiagonal components of
the correlation tensor, even though being zero for zero-
space separation ($r = 0$), acquire, in general, non-
vanishing values when r is not equal to 0. The mag-
netic and mixed correlation tensors are so discussed.
Expressions are derived for the electromagnetic cor-
relation tensors of blackbody radiation defined on the
basis of the theory of the quantized field. Correlation
functions of all order are considered, but second-order
ones are discussed in detail; it is found that these are
identical with those obtained on the basis of semiclassi-
cal theory in part 1 of this investigation.

2360

Rochester U. Dept. of Physics and Astronomy, N. Y.

RECENT RESEARCH ON COHERENCE PROPERTIES
OF LIGHT, by E. Wolf. [1964] [22]p. incl. diagrs.
refs. (AFOSR-65-0436) (AF AFOSR-63-237)
AD 612320   Unclassified

Also published in Quantum Electronics III, ed. by P. Grivet and N. Bloembergen. New York, Columbia U. Press, v. 1: 13-34, 1964.

A brief review is presented of the basic notions and results of a theory formulated within the framework of classical optics to explain optical coherence phenomena. A stochastic description of light is given. Coherence effects of the second and fourth order are also presented.

2361

Rochester U. Dept. of Physics and Astronomy, N. Y.

LIGHT FLUCTUATIONS AS A NEW SPECTROSCOPIC TOOL, by E. Wolf. [1964] [2]p. (AFOSR-65-0442) (AF AFOSR-63-237) AD 612501   Unclassified

Presented at Internat'l. Commission for Optics Conf. on Photographic and Spectroscopic Optics, Tokyo and Kyoto (Japan), Sept. 1-8, 1964.

A summary is given of a lecture on basic concepts relating to the theory of light fluctuations, features which distinguish the fluctuation properties of thermal and laser light, and new techniques for obtaining information about spectra from fluctuation and correlation measurements. In particular, methods depending on beat phenomena, photo-electric mixing experiments, intensity correlation interferometry, photon coincidence experiments and pulse counting techniques will be reviewed and the possibility of obtaining spectral information from statistical studies of transient interference patterns are considered. Current researches relating to the determination of the phase of the second order complex degree of coherence are discussed. The concept of higher order spectra is explained and the possibility of obtaining some information about them from multiple photon coincidence experiments is mentioned.

2362

Rochester U. Dept. of Physics and Astronomy, N. Y.

STATIONARITY AND THE RANDOM PHASE CONDITION IN THE STATISTICAL THEORY OF THE ELECTROMAGNETIC FIELD, by Y. Kano. [1964] [11]p. incl. refs. (AFOSR-65-1113) (AF AFOSR-62-237) AD 620474   Unclassified

Also published in Ann. Phys., v. 30: 127-137, Oct. 1964.

The quantum mechanical analogue of the classical definition of stationarity of an electromagnetic radiation field is discussed. It is shown to imply that for an ensemble radiation field corresponding to a single momentum-spin state the phase space distribution function of the complex eigenvalues of the photon annihilation operators does not depend on the phases of the eigenvalues, i. e., the stationarity condition implies a uniform distribution of the phase angle of the eigenvalues. However, for a radiation field with a finite or countable infinite number of states, the stationarity condition is not a sufficient condition for the phase

independence of the distribution function; it is shown that, in addition, the commutability of the density matrix and the number operator for each mode is required. The physical meaning of this commutability is investigated and it is shown to imply homogeneity of the radiation field.

2363

Rochester U. Dept. of Physics and Astronomy, N. Y.

DETERMINATION OF THE STATISTICAL PROPERTIES OF LIGHT FROM PHOTOELECTRIC MEASUREMENTS, by E. Wolf and C. L. Mehta. [1964] [3]p. incl. refs. (AFOSR-65-1114) (AF AFOSR-63-237) AD 620475   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 705-707, Dec. 14, 1964.

It is shown that it is possible, in principle, to determine the complete probability density of the intensity in a fluctuating light beam from the knowledge of the statistical distribution of photoelectrons released from a photosensitive surface on which the beam is incident. Results indicate that the distribution of the photoelectrons is strictly Poissonian if and only if the incident light is perfectly stabilized in the sense that the time-integrated intensity does not fluctuate.

2364

Rochester U. [Dept. of Physics and Astronomy] N. Y.

PROCEEDINGS OF SEMINAR ON UNIFIED THEORIES OF ELEMENTARY PARTICLES, by D. Lurie and N. Mukunda. July 1963, 427p. (Rept. no. 11) (AFOSR-64-1053) (AF AFOSR-63-427) AD 601502   Unclassified

The following topics are discussed: Vector mesons as bound states, Electron as an energy gap in a cutoff free approximation, Some problems in the theory of the symmetries of strong interactions, Some problems in the theory of the symmetries of strong interactions, Strong coupling solutions of vector coupled fields, Broken symmetries and unconventional solutions of standard field theory, Interaction among gauge vector fields. Considerations on the self-consistent breakdown of symmetries, Some equivalent approaches to the self-consistent bound state of strongly interacting particles, Broken symmetries and zero mass bosons, Broken symmetries, a possible connection between Lorentz space and isotopic spin space, Gauge invariant and gauge covariant Green's functions, Mass differences of particles, Nonlinear spinor model, Aspects of Euclidean field theory and Feynman path integrals, Unsubtracted dispersion relations for weak interactions and the Goldberger-Treiman relation, Broken symmetries in terms of inequivalent representations, and An unconventional view of perturbation expansions.

2365

Rochester U. Dept. of Physics and Astronomy, N. Y.

ISOTOPIC COMPOSITION AND ENERGY SPECTRUM OF LOW-ENERGY HELIUM NUCLEI IN PRIMARY COSMIC RADIATION, by C. Dahanayake, M. F. Kaplon, and P. J. Lavakare. [1964] [19]p. incl. diagrs. tables, refs. (AFOSR-64-2047) (AF AFOSR-63-439) AD 612534   Unclassified

Also published in Jour. Geophys. Research, v. 69: 3681-3699, Sept. 1, 1964.

The isotopic composition and the energy spectrum of low-energy helium nuclei were investigated, using a nuclear emulsion stack flown from Fort Churchill, Canada, on Aug. 4, 1962. The proportion of He^3 nuclei at the top of the atmosphere was determined to be $18 \pm 5\%$ within the kinetic energy interval of 160-370 mev/nucleon and $24 \pm 8\%$ within the rigidity interval 1.1-1.4 bv/c. The differential energy spectrum in the above energy interval was found to have a maximum around 275-300 mev/nucleon. Assuming that there is no He^3 at the cosmic-ray sources, and that the observed abundance reflects the interactions of the primary radiation in its passage through interstellar matter, we conclude that the low-energy primary radiation has traveled a total of 6 ± 2 g/sq cm in this medium. This result is found to be consistent with the values obtained from the low-energy lithium, beryllium, and boron experiment. The implications of these results are examined on the basis of different models used for the propagation of cosmic radiation through interstellar matter.

2366

Rochester U. Dept. of Physics and Astronomy, N. Y.

ISOTOPIC COMPOSITION OF LOW ENERGY HYDROGEN NUCLEI IN THE PRIMARY COSMIC RADIATION, by G. D. Badhwar. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-1344) (AF AFOSR-63-439) AD 604098
                Unclassified

Also published in Jour. Geophys. Research, v. 69: 4435-4439, Nov. 1, 1964.

The abundance of low energy deuterons and tritons was determined in a nuclear emulsion stack exposed at Fort Churchill, Manitoba, Canada on Aug. 4, 1962, under 4.2 g/cm^2 of residual atm. Using the grain density versus residual range method for the identification of tracks produced by particles, the differential flux of deuterons and tritons was determined. The results appear to be consistent with the absence of deuterons and tritons in the primary cosmic radiation. An upper limit has been placed on the amount of hydrogen traversed by low energy cosmic ray particles.

2367

Rochester U. Dept. of Physics and Astronomy, N. Y.

A HEURISTIC MODEL FOR THE VARIATION WITH

RIGIDITY OF THE COSMIC-RAY CHARGE SPECTRUM, by M. F. Kaplon and G. Skadron. [1964] [25]p. incl. diagrs. tables. (AFOSR-66-0798) (AF AFOSR-63-439) AD 443044   Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1687-1711, Dec. 16, 1964.

An idealized model based on the supernova origin of cosmic radiation is proposed to account for the variation with rigidity of the cosmic-ray charge spectrum. It is assumed that a supernova explosion results in the injection of a pure power-law spectrum and a composition relatively rich in heavy nuclei. Particles are confined within a volume local to the source region by a magnetic boundary resulting in a rigidity-dependent coefficient of reflectivity; this yields a source-region path length varying inversely with rigidity. As a result, the differential spectra of particles escaping from the boundary into the galaxy are determined by the reflectivity; and as a result of the nuclear interactions in the source region, the composition varies with rigidity. The additional effect of intragalactic motion is taken into account and the differential rigidity spectra, as a function of composition at the earth, are calculated. Predictions for the H/M, L/M, and He^3/H^4 ratios as a function of rigidity as well as the differential rigidity spectra are compared with experiment and are not in disagreement with the available data. The limitations and plausibility of the model are summarized and discussed. (Contractor's abstract)

2368

Rochester U. [Dept. of Physics and Astronomy] N. Y.

SOME SOLVABLE POTENTIALS FOR THE SCHRODINGER EQUATION, by H. H. Aly and R. M. Spector. Mar. 13, 1964, 11p. (Rept. no. UR 875-25) (AF AFOSR-63-439) AD 439424   Unclassified

Utilizing the modified Mathieu differential equation and Darboux's theorem for second order differential equations, some solvable potentials for the Schrodinger equation are constructed. The limitations of the potentials constructed by the use of Darboux's theorem are pointed out and discussed.

2369

Rochester U. Dept. of Physics and Astronomy, N. Y.

DYNAMIC EFFECTS OF VARIABLE G OR INVARIABLE MASS, by M. P. Savedoff and S. Vila. [1964] [4]p. incl. diagr. tables. (AFOSR-64-1916) (AF AFOSR-64-603) AD 450519   Unclassified

Also published in Astronom. Jour., v. 69: 242-245, Apr. 1964.

Two-body motion with time-dependent coupling is discussed for two cases: coupling varying linearly or inverse linearly with time. The inverse linear motion can be treated rigorously using a transformation due to Meshcherskii.

2370

Rochester U. [Dept. of Physics and Astronomy] N. Y.

CALCULATION OF THE G FACTOR OF HYDROGEN
AND THE ALKALI ATOMS TRAPPED IN RARE-GAS
SOLIDS, by D. Y. Smith. [1964] [11]p. (AFOSR-64-
1765) (AF AFOSR-64-611) AD 449091   Unclassified

Also published in Phys. Rev., v. 133: A1087-A1097,
Feb. 17, 1964.

The author's variational method of calculating g-factor
shifts for atomic hydrogen trapped in a rare-gas solid
is applied to the case of the alkali metals as impuri-
ties. An alternate derivation of the results is given
and a simple physical model is discussed. The calcu-
lated shifts are compared with the experimentally ob-
served ones for H, Li, Na, and K trapped in Ne, Ar,
and Kr. Reasonable agreement is obtained if it is
assumed that where two resonances have been reported
the impurities are trapped at substitutional and octa-
hedral interstitial lattice sites. The connection be-
tween the variational formalism and a previous pertur-
bation treatment of Adrian is discussed and it is shown
that a reinterpretation of the latter yields improved
agreement with experiment. Crude estimates of the
relaxation about substitutional and interstitial impuri-
ties are also given.

2371

Rochester U. Inst. of Optics, N. Y.

A GENERAL LINEARIZATION METHOD FOR AUTO-
MATIC LENS CORRECTION, by G. H. Spencer. 1963,
18p. (AFOSR-4761) (AF 49(638)668) AD 407605
                                              Unclassified

The use of programmed computing machinery for auto-
matic lens correction requires a definite prescription
according to which a lens system may be adjudged:
(1) acceptable or not acceptable; or (2) improved or
not improved over a previous configuration. Judg-
ments of the first kind may be made on the basis of
whether or not a given set of equations are satisfied;
judgments of the second kind, on the basis of whether
or not the value of a 'merit function' has been reduced.
A typical lens design problem will involve both abso-
lute requirements, to which a judgment of the first
kind is appropriate, and relative requirements calling
for a judgment of the second kind. A linearization
method designed to accommodate requirements of both
types is described. Several previously described
linearization procedures are shown to be included
within the framework of the present method.

2372

Rochester U. Inst. of Optics, N. Y.

THE SYMPOSIUM LENS - AN EPILOGUE, by R. E.
Hopkins and D. P. Fader. [1963] [5]p. (AFOSR-65-
0099) (AF AFOSR-63-50) AD 455832   Unclassified

Also published in Appl. Opt., v. 2: 1227-1231, Dec.
1963.

A lens design problem was proposed by a group of lens
designers. Several alternative designs have been cor-
rected on two different automatic correcting programs.
The final designs are similar and exhibit a high degree
of correction.

2373

Rochester U. Inst. of Optics, N. Y.

A FLEXIBLE AUTOMATIC LENS CORRECTION PRO-
CEDURE, by G. H. Spencer. [1963] [8]p. incl. diagrs.
tables, refs. (AFOSR-65-0101) (AF AFOSR-63-50)
AD 455833   Unclassified

Also published in Appl. Optics, v. 2: 1257-1264,
Dec. 1963.

Since the advent of high-speed automatic computing ma-
chinery, workers in the field of optical design have
been intrigued by the idea of automating the lens de-
sign process. Various methods have been proposed and
tested. Most of these do not allow sufficient control to
be exercised over the nature of the design solution.
Those which do allow such control appear to be ineffi-
cient because of slow convergence to a solution. A cor-
rection procedure is described which permits a high
degree of control over the nature of the design solution
and which has shown a reasonably good rate of converg-
ence in a limited number of tests. The operation of a
computer program to conduct the procedure is de-
scribed, and the results of a typical design problem are
presented. (Contractor's abstract)

2374

Rochester U. Inst. of Optics, N. Y.

A SERIES OF LENSES DESIGNED ON LARGE COM-
PUTERS, by R. E. Hopkins. [1965] [6]p. incl. diagrs.
tables. (AFOSR-65-0444) (AF AFOSR-63-50)
AD 612500   Unclassified

Also published in Internat'l. Commission for Optics,
Conf. on Photog. and Spectros. Optics, Tokyo and
Kyoto (Japan), Sept. 1-8, 1964.

In this study four lenses were designed to meet a given
set of specifications by using a powerful automatic cor-
recting program. The designs provide information on
what one may expect for performance from lenses of
this type, and data gathered can be used to predict
performance for a range of other problems. The geo-
metrical energy distributions, the geometrical modu-
lation transfer curves, and the design data are given
for the lenses.

2375

Rochester U. Inst. of Optics, N. Y.

1s-2p TRANSITION OF H AND D IN SOLID ARGON,

by G. Baldini. [1964] [4]p. incl. diagrs. refs.
(AFOSR-65-0403) (AF AFOSR-63-236)   Unclassified

Also published in Phys. Rev., v. 136: A248-A251, Oct.
5, 1964.

The 1s-2p transition of hydrogen and deuterium atoms
diluted in solid inert gases has been observed and its
energy and half-width measured. In argon, absorption
occurs at the energies of 10.55 and 10.565 ev and the
half-widths are 0.27 and 0.23 ev, respectively, for H
and D. An analysis of these results leads to an esti-
mate of the frequency of a localized vibrational mode
associated with the H and D impurities.

2376

Rochester U. Inst. of Optics, N. Y.

EMISSION SPECTRA OF KI:T1 AT 12°K, by K.
Teegarden. [1964] [2]p. incl. diagrs. (AFOSR-65-
0404) (AF AFOSR-63-236) AD 612656   Unclassified

Also published in Phys. Rev., v. 136: A1091-A1092,
Nov. 16, 1964.

Emission spectra were measured for separate excita-
tion by light absorbed in the A, B, C, and D impurity
absorption bands of single crystals of KI:T1 at 12°K.
Five emission bands are reported. Three emission
bands are identified as direct transitions from the en-
ergy levels related to the A, B, and C absorption bands.
Excitation in the D absorption band is found to excite
an additional low-energy emission band which corre-
sponds to a forbidden transition in absorption.

2377

Rochester U. Inst. of Optics, N. Y.

ULTRAVIOLET ABSORPTION OF SOLID DEUTERIUM,
by G. Baldini. [1964] [4]p. incl. diagrs. (AFOSR-
64-0443) (AF AFOSR-63-236) AD 612638
                                      Unclassified

Presented at Internat'l. Commission for Optics Conf.
on Photographic and Spectroscopic Optics, Tokyo and
Kyoto (Japan), Sept. 1-8, 1964.

In the course of studying the optical properties of the
simplest molecular solids in the far ultraviolet, deu-
terium was investigated and its absorption spectrum is
reported here. Rare gas impurities introduced into
the solid yield additional information about its elec-
tronic and optical properties.

2378

Rochester U. Inst. of Optics, N. Y.

OPTICAL PROPERTIES OF SOLID RARE GASES AND
THEIR ALLOYS, by G. Baldini. Aug. 1964, 19p.
(AFOSR-67-1384) (AF AFOSR-63-236) AD 612715
                                      Unclassified

Presented at 1964 Spring meeting of the Amer. Phys.
Soc., Philadelphia, Pa.

The theory of excited states in insulators is outlined,
the optical absorption spectra of the solid rare gases
shown and the experimental results discussed in the
light of available theoretical models.

2379

Rome U. (Italy).

NEUROPHYSIOLOGICAL STUDIES OF BEHAVIOUR, by
G. Ricci. Final technical rept. Apr. 1, 1963-Mar. 31,
1964. May 1, 1964, 12p. (AFOSR-64-1089)
(AF EOAR-63-90) AD 601689   Unclassified

The results of the investigation of (1) behavior and EEG
modifications induced by anticholinergic drugs and their
combination with amphetamine, (2) modifications of cor-
tical evoked responses after administration of atropine
and amphetamine, and (3) modifications of the responses
evoked in subcortical structures during avoidance condi-
tioning experiments in the monkey are summarized.
Small doses of amphetamine given to animals previ-
ously treated with anticholinergic agents restored the
conditioned responses while not modifying the EEG ac-
tivity. The cholinolytic drugs potentiated the excitatory
effects of amphetamine. Amphetamine, given to pre-
viously atropinized animals restored the stage of di-
minished amplitude of the cortical responses both in the
somatic and visual areas, in spite of the absence of
clear-cut EEG modifications. A method was devised
for implanting multiple electrodes in deep structures of
the brain of the monkey. The preliminary results ob-
tained with the study of the responses evoked in these
structures during avoidance conditioning experiments
are reported.

2380

Rome U. (Italy).

EFFECTS OF ATROPINE ON THE EEG AND CONDI-
TIONING IN THE MONKEY, by G. F. Ricci and L.
Zamparo. [1963] [2]p. (AFOSR-65-0306) (AF EOAR-
63-90) AD 612569   Unclassified

Also published in Arch. Ital. Sci. Farmacol., Series
III, v. 13: 3-4, July 1963.

Previous workers who had studied the effects of atro-
pine on animal behavior had claimed that the classical
EEG picture produced by the drug (slowing of cortical
activity and disappearance of the arrest reaction to ex-
ternal stimuli) was not accompanied by behavioral
changes. The authors employed classical conditioning
techniques to refine behavioral measurements. They
concluded that atropine (and probably anticholinergic
drugs in general) can exert a measurable effect on at-
tention and the learning process.

2381

Rome U. (Italy).

THE ROLE OF CEREBRAL CHOLINERGIC STRUC-
TURES IN LEARNING: RELATIONSHIP BETWEEN
CONDITIONED RESPONSES AND THE EEG ARREST
REACTION, by G. F. Ricci and L. Zamparo. [1964]
[4]p. (AFOSR-65-0307) (AF EOAR-83-90) AD 612568
Unclassified

Also published in Riv. Neurol., v. 34: 283-286,
May-June, 1964.

Earlier work by the authors had shown that atropine, in
doses sufficient to alter the resting EEG and arrest
reaction, also altered classical conditioned responses
(i. e., affected behavior). The current report deals
with other anticholinergics, a cholinesterase, and a
sympathomimetic. Scopolamine and benactyzine ex-
erted effects similar to atropine. Eserine, when ad-
ministered by itself, altered both the EEG and condi-
tioned responses; but when administered to monkeys
pretreated with an anticholinergic, it caused the EEG
to return to normal and restored conditioned reflexes.
Amphetamine given to monkeys pretreated with an an-
ticholinergic did not alter the anticholinergic EEG pat-
tern, but did restore the conditioned response. The
authors propose a possible explanation for the differing
effects between the cholinergic and sympathomimetic
drugs.

2382

Rome U. School of Aeronautical Engineering (Italy).

MODELING TECHNIQUE IN HEAT TRANSFERS. Jan.
1963 [15]p. incl. illus. diagrs. (Technical rept. no.
3; SIARgraph no. 88) (AFOSR-5403) (AF 81(052)198)
AD 424339 Unclassified

The present paper is a general summary of the work
developed during 1962. Theoretical research includes
solution of heat conduction in solids and radiation prob-
lems. Experimental research includes investigations
on the effect at the stagnation point.

2383

Rome U. School of Aeronautical Engineering (Italy).

GENERAL SATELLITE DYNAMICS. PART 1. EF-
FECT OF AIR DRAG, by L. Broglio. June 1983
[24]p. incl. diagrs. (Technical note no. 8; SIARgraph
no. 87) (AFOSR-5404) (AF 61(052)198) AD 423988
Unclassified

Presented is a study of the determination of the satel-
lites lifetime under the action of an external source of
perturbation being it represented by the aerodynamic
drag alone. A new theoretical method is presented
which allows the problem to be solved in a very quick
and easy way by determining some "universal" curves
thus noticeably simplifying the numerical work involved
in the commonly used calculation procedures, and is

particularly suitable to be applied to mean size com-
puters. The theoretical research is completed by nu-
merical results and graphs.

2384

Rome U. School of Aeronautical Engineering (Italy).

EFFECT OF A CONCENTRATED INJECTION AT THE
FORWARD STAGNATION POINT OF A BLUNT BODY
UNDER HYPERSONIC CONDITIONS, by U. Ponzi and
A. Castellani. Final rept. Dec. 1964 [24]p. incl.
illus. diagrs. tables. (AFOSR-65-1137) (AF 81(052)-
198) AD 619514 Unclassified

A preliminary set of results are presented on the effects
of high rate of injection localized at the forward stag-
nation point of a blunt body under hypersonic condi-
tions. The device is envisaged as a possible means to
deform the effective shape of noses of vehicles reenter-
ing from interplanetary missions; an attempt is made
to establish an analogy with spiked bodies. Pressure
distribution and heat transfer data are obtained for a
Mach number equal to 8 and Reynolds number
$0.2.10^8 \div 0.3.10^8$ and injection rates ranging between
$C = 0.1 \div 0.8$.

2385

Royal Coll. of Science and Tech. Dept. of Mathematics,
Glasgow (Scotland).

STEADY AND UNSTEADY MOTION IN MAGNETOGAS-
DYNAMICS. Final technical rept., pt. 1, July 31,
1963, 6p. (AFOSR-4773, pt. 1) (AF EOAR-81-49)
AD 408384 Unclassified

Equations are derived giving the changes across a
shock of arbitrary shape and velocity moving in an in-
viscid gas in which the electrical conductivity varies
with the temperature. The analysis is used for the
study of deflagration in a combustible gas. A model is
taken consisting of a flame, considered to be a discon-
tinuity at which energy is released, ahead of which runs
a shock, sufficiently strong to ionize completely the
previously non-conducting gas. The Hugoniot curve for
the shock reveals two patterns, one similar to the gas-
dynamic, the other corresponding to density ratios
greater than the maximum permitted in gasdynamics.
The modified Hugoniot curve for the flame is similar
to that obtained in gasdynamics.

2386

Royal Coll. of Science and Tech. Dept. of Mathematics,
Glasgow (Scotland).

STEADY AND UNSTEADY MOTION IN MAGNETO-
FLUID DYNAMICS, by D. C. Pack. Final technical
rept. Dec. 31, 1983, 4p. (AFOSR-64-0725)
(AF EOAR-63-22) AD 438560 Unclassified

The one-dimensional propagation of a steady detonation
wave and also of a deflagration wave in a tube closed
at one end is studied for the situation in which the

electrical conductivity jumps from zero to infinity across the leading shock owing to ionization of the gas. An analysis has been made of the jump relations for zero to infinity when the magnetic field is oblique and the upstream particle velocity and magnetic field are coplanar. Special attention is paid to switch-on and switch-off gas-ionizing shocks. A summary is given of work done on supersonic flow of electrically conducting fluid past a non-conduction wedge when there are four attached shocks.

2367

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

POTENTIOMETRIC PURITY CONTROL OF SALT MEDIA FOR EQUILIBRIUM STUDIES. WITH AN APPENDIX ON THE ANALYSIS OF DILUTE SOLUTIONS OF STRONG ACIDS, by L. Ciavatta. [1963] [19]p. incl. diagrs. tables. refs. (AFOSR-64-1456) (AF 61(052)-162) AD 445023   Unclassified

Also published in Arkiv Kemi, v. 20: 417-435, 1963.

A potentiometric titration method, employing a glass or a hydrogen electrode, is described for the estimation of trace amounts of weak acids and oxidizing agents that are often present in solution of salts commonly used as ionic media ($LiClO_4$, $NaClO_4$, Na_2SO_4, NaCl, KCl). The titration is carried out by coulometric generation of OH. Potentiometric titration combined with coulometry serves well for the analysis of dilute solutions of strong acids. For an acid concentration of 10^{-3} M results accurate within ± 0.1% could be attained, in 10^{-4} M solutions the uncertainty of the titration did not exceed ± 1%. (Contractor's abstract)

2366

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE STRUCTURES OF SOME HYDROXO SALTS OF Al^{3+}, Ga^{3+}, In^{3+} AND Tl^{3+}, by G. Johansson. [1963] [22]p. incl. diagrs. tables. refs. (AFOSR-65-1441) (AF 61(052)162) AD 621461   Unclassified

Also published in Svensk Kemisk Tidskrift, v. 75: 41-62, 1963.

A survey is presented of the crystal structure of some hydroxide sulfates and selenates of Al^{3+}, Ga^{3+}, In^{3+}, and Tl^{3+}. Their relations to other structures, particularly to those of the hydroxides, are discussed and an attempt is made to relate the structures of the metal-oxygen complexes in the solids with the composition of the polynuclear complexes determined from investigations on hydrolyzed solutions.

2369

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

THE ION ACTIVITY FUNCTION - AN APPROACH TO THE STUDY OF ELECTROLYTE BEHAVIOUR IN CONCENTRATED SOLUTIONS, by L. Leifer and E. Hogfeldt. [1963] [6]p. incl. diagrs. table, refs. (AFOSR-67-1292) (AF 61(052)162)   Unclassified

Also published in Electrochemistry; Proc. First Australian Conf., Sydney (Feb. 13-15, 1963) and Hobart (Feb. 16-20, 1963), New York, Pergamon Press, 1964, p. 107-114.

The combination of Hammett acidity and activity data allowed determination of ion activity and ion activity coefficient functions for the ions in several divalent metal perchlorate-water systems as well as in hydrochloric acid-water mixtures. The fact that a unique ion activity function was obtained for H_3O^+ in several strong acids permits calculation of at least approximate values for ionic hydration as a function of composition. Further, the results indicate the marked stability of $H_9O_4^+$ in concentrated HCl solutions and a likely mechanism for the acid dissociation. (Contractor's abstract)

2390

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

EQUILIBRIUM STUDIES OF POLYANIONS CONTAINING B^{III}, Si^{IV}, Ge^{IV}, AND V^V, by N. Ingri. [1963] [32]p. incl. diagrs. tables, refs. (AFOSR-64-1799) (AF EOAR-63-8) AD 449076   Unclassified

Also published in Svensk Kemisk Tidskrift, v. 75: 3-34, 1963.

This paper is a summary of earlier published studies on the equilibria between aqueous polyanions containing B^{III}, Si^{IV}, Ge^{IV} and V^V. These studies have given the composition and equilibrium constants of the main species. A comparison has been made between the complexes found in solution and those found in crystals. From this comparison tentative structures have been given for the proposed polynuclear complexes.

2391

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE HYDROLYSIS OF NIOBATES IN 3 M K (Cl) MEDIUM, by G. Neumann. [1964] [3]p. incl. diagr. (AFOSR-65-1244) (AF EOAR-63-6) AD 621262   Unclassified

Also published in Acta Chem. Scand., v. 18: 278-280, 1964.

An investigation was made of ionic molecular species

in aqueous solutions of alkali metal niobates. The primary objective of the present work was to decide whether hexa- or pentaniobates predominate in solution. Preliminary results are reported.

2392

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS. PART 49. AN EMF STUDY OF LITHIUM HYDROXIDE IN 3 M (NaClO)$_4$ MEDIUM, by H. Ohtaki. [1964] [3]p. incl. diagrs. tables, refs. (AFOSR-65-1245) (AF EOAR-63-8) AD 621283   Unclassified

Also published in Acta Chem. Scand., v. 18: 521-533, 1964.

An emf study has been made in a system of various concentrations of lithium and hydroxide ions in sodium perchlorate medium using a hydrogen electrode at 25°C. From the difference in emfs between sodium hydroxide solutions with and without lithium ions, the following formation constant of lithium hydroxide was estimated: $Li^+ + OH^- \rightleftharpoons LiOH$, $K = 0.66 \pm 0.02$ ($\log K = -0.18 \pm 0.01$).

2393

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ARE AQUEOUS METAVANADATE SPECIES TRINUCLEAR, TETRANUCLEAR, OR BOTH? PRELIMINARY LETAGROP RECALCULATION OF EMF DATA, by F. Brito, N. Ingri, and L. G. Sillen. [1964] [2]p. incl. table, refs. (AFOSR-65-1246) (AF EOAR-63-8) AD 621346   Unclassified

Also published in Acta Chem. Scand., v. 18: 1557-1558, 1964.

Emf measurements on metavanadate solutions at 25°C in alkaline 0.5 M Na(Cl) medium were recalculated by means of the computer program, LETAGROP. The results obtained indicate that both trinuclear and tetranuclear species are present in the metavanadate solutions.

2394

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDY OF THE HYDROLYSIS EQUILIBRIA OF CATIONS BY EMF METHODS, by G. Biedermann. [1964] [23]p. incl. diagr. table, refs. (AFOSR-65-1247) (AF EOAR-63-8) AD 621266   Unclassified

Also published in Svensk Kemisk Tidskrift, v. 76: 1-23, 1964.

A survey is presented of the experimental and interpretational problems which were encountered when the composition of the products of ionic reactions, especially those of hydrolysis, was determined by emf measurements. Sixteen investigations provide the data for this survey and these are listed as publications. An equilibrium analysis was used in all of the investigations.

2395

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON EQUILIBRIA IN POLYMOLYBDATE SOLUTIONS, by Y. Sasaki and L. G. Sillen. [1964] [I]p. (AFOSR-65-1248) (AF EOAR-63-8) AD 621236   Unclassified

Also published in Acta Chem. Scand., v. 18: 1014, 1964.

Preliminary results are presented for equilibria in polymolybdate solutions. The data have been treated by means of improved versions of the computer program LETAGROP, which was designed in order to adjust six and more equilibrium constants by simultaneous variation. The measurements are as yet, however, in a fairly unfavorable range for deriving a general formula.

2396

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS XLIV. EXTRACTION STUDY OF THE HYDROLYSIS OF VANADIUM (V) AT VERY LOW CONCENTRATION IN ACID PERCHLORATE MEDIA, by D. Dyrssen and T. Sekine. [1964] [11]p. incl. diagrs. table, refs. (AFOSR-65-1275) (AF EOAR-63-8) AD 622889
                                        Unclassified

Also published in Jour. Inorg. and Nucl. Chem., v. 26: 981-991, 1964.

The distribution of carrier-free V^{48} between methyl isobutyl carbinol (hexol) and 0.5 M (H, NaClO$_4$) has been measured radiometrically at 25°C as a function of $-\log [H^+]$. Both curve-fitting and Letagrop adjustment with a high-speed computer were used to evaluate constants for the following equilibria: $VO_2 + H_2O \rightleftharpoons HVO_3 + H^+$, $\log K_I = -3.20 \pm 0.09$; $HVO_3 \rightleftharpoons VO_3- + H^+$, $\log K_2 = -3.78 \pm 0.09$; and $HVO_3(aq) \rightleftharpoons HVO_3(hexol)$, $\log \lambda = 1.99 \pm 0.09$.

2397

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS.

PART 50. THE HYDROLYSIS OF THE YTTRIUM(III) ION Y^{3+}, by G. Biedermann and L. Ciavatta. [1964] [27]p. incl. diagrs. tables, refs. (AFOSR-65-1648) (AF EOAR-63-8) AD 624324   Unclassified

Also published in Arkiv Kemi, v. 22: 253-279, 1964.

The hydrolysis equilibria of the Y^{3+} ion have been studied at 25°C by measuring with a quinhydrone or a glass half-cell the hydrogen ion concentration of a series of yttrium perchlorate solutions. The $[Y(III)]$ of the test solutions, which were made to contain 3 M $C'O_4^-$ by adding $LiClO_4$, ranged from 0.025 to 1 M. Solutions having an appreciable concentration of hydrolysis products were prepared by two methods: (1) saturating a slightly acidic yttrium perchlorate solution with hydrous yttrium oxide, (2) generating OH^- ions by constant current electrolysis in an initially unhydrolyzed solution and measuring with a coulometer the amount of electricity used. The data obtained in solutions prepared by these methods were found to be in agreement with the emf measurements.

2398

Rutgers U. [Dept. of Physics] New Brunswick, N. J.

A STUDY OF THE PROPERTIES OF MATTER BY MEANS OF NUCLEAR MAGNETIC RESONANCE, by H. C. Torrey and H. Y. Carr. Final rept. Jan. 1, 1960-Dec. 31, 1962. Jan. 30, 1963, 13p. incl. table. (AFOSR-4643) (AF 49(638)755) AD 408547
                                                  Unclassified

The small magnets contained in the nuclei of the materials studied provide a means to investigate microscopic details of the environment surrounding the nuclei. These very small magnets transmit signals at a resonance frequency determined in the first approximation by the values of a strong externally applied magnetic field. But the detailed shapes, intensities, and time dependence of the transmitted signals are determined by the electric and magnetic fields associated with the local nuclear environment. By interpretating detailed properties valuable information has been gained concerning the coupling in electron-nuclear systems, the local magnetic fields present during molecular collisions in simple monatomic fluids such as xenon, and the fundamental interactions present in the important diatomic fluid, hydrogen.

2399

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

THE IMPACT OF PHOTOCOPYING ON SCHOLARLY PUBLISHING, by R. F. Clarke. [1963] [5]p. incl. tables. (AFOSR-J1148) (AF AFOSR-62-9) AD 440397
                                                  Unclassified

Also published in Library Jour., July 1963, p. 2625-2629.

Claims that photocopying has a damaging effect upon publishing are not substantiated by evidence and should be disregarded. Libraries should continue to copy scholarly materials as they do at present. If technology alters the situation, a study of this kind should be repeated. Internal multiple-copy photocopying of materials should be studied as a separate and different problem. Librarians should anticipate journal needs further into the future, and should not assume that photocopying is automatically more economical than subscription. Libraries should keep sufficient data to make valid subscription decisions, and should subscribe to journals with subscription prices of $30 per year or less if one-year volumes are needed an average of once per year over a 20-yr period or longer.

2400

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

MEASURE OF INDEXING, by S. Artandi. [1964] [7]p. incl. tables. (AFOSR-64-2260) (AF AFOSR-62-9) AD 452527   Unclassified

Also published in Library Resources and Technical Services, v. 8: 229-235, Summer 1964.

In conjunction with a research project on the automatic indexing of natural language textual materials measures were developed to permit useful comparison of the mechanically produced index for an inorganic chemistry textbook with the average, conventionally-produced index for the same type of material. Evaluation of indexing can be done from the point of view of: (1) the individual product, and (2) the product as compared to other products of the same species, the product as a member of a group. The measures were developed primarily with book indexing in mind and as of this time have not been related to the indexing of periodical, patent, or report literature. Evaluation is based on three criteria: (1) Density of indexing, (2) Distribution of indexing, and (3) Completeness of indexing. Both density and distribution can be measured in a completely objective manner.

2401

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

AUTOMATIC BOOK INDEXING BY COMPUTER, by S. Artandi. [1964] [8]p. incl. diagrs. tables. (AFOSR-65-0090) (AF AFOSR-64-531) AD 611464 Unclassified

Also published in Amer. Doc., v. 15: 250-257, Oct. 1964.

This paper describes the development and evaluation of an automatic method of deriving suitable index entries from natural language text. A section of a chemistry textbook was selected as the experimental document. Qualitative and quantitative measures were developed to evaluate quality of indexing. Evaluation of the experimental index was based on these measures and on a comparison with the average published manually produced index found in the same type of material.

2402

Saarlandes U., Saarbrücken (Germany).

[THE POSITION OF FOUR RESPONSE VARIABLES IN
A FACTOR ANALYSIS AND THEIR RELATIONSHIP TO
ANXIETY AND STRESS] Die Stellung von vier motoris-
chen Variablen in einer Faktorenanalyse und ihre
Beziehungen zu Angst und Stress, by O. Spreen. [1964]
[16]p. incl. tables, refs. (AFOSR-65-0594) (AF 61-
(052)483)   Unclassified

Also published in Psychol. Forsch., v. 27: 403-418,
1964.

In a factor analysis of 40 variables, the position of 4
response variables was investigated: (a) response rate;
(b) tapping rate, i.e., finger oscillation; (c) touch
pressure with tapping; and (d) steadiness of the hand
with continuous activity. For these 4 variables signifi-
cant loads [i.e., Ladungen] were found for 3 out of 16
extracted factors in the total analysis. The reaction
time showed a [load] for an individual factor "response
rate," the tapping rate showed a [load] for a factor for
"fine response rate," the touch pressure with tapping
showed a [load] for a "response coordination factor"
and the factor for "fine response rate," and the steadi-
ness of the hand showed a [load] also for the "response
coordination factor." In an analysis of the 4 variables
and additional data, no significant effect of the general
anxiety level was found on the response performance
considered here.

2403

St. Bartholomew's Hospital, London (Gt. Brit.).

RESEARCH ON DRUGS ON NEURONAL TRANSMIS-
SION, by J. P. Quilliam. Final rept. Jan. 1964, 85p.
incl. illus. diagrs. tables, refs. (AFOSR-64-0951)
(AF 61(052)25)   Unclassified

The actions of centrally active drugs and related com-
pounds on transmission across the synapses of the
superior cervical ganglion of the cat, rabbit and rat
have been studied because these synaptic junction may
be regarded as being closely allied to those seen be-
tween central neurones. Experiments on the cat
ganglion were made in vivo on the isolated ganglia of
the rabbit and the rat were made in vitro and usually
involved the application of single stimuli to the pre-
ganglionic trunk with recording of the evoked ganglionic
or postganglionic action potentials. The results are
summarized in two parts, firstly, quantitative findings
and secondly, qualitative observations with particular
reference to modes of action.

2404

St. Bartholomew's Hospital, London (Gt. Brit.).

THE EFFECTS OF CHOLINE AND OTHER FACTORS
ON THE RELEASE OF ACETYLCHOLINE FROM THE
STIMULATED PERFUSED SUPERIOR CERVICAL

GANGLION OF THE CAT, by E. K. Matthews. [1963]
[6]p. (AFOSR-64-1086) (AF 61(052)25) AD 441472;
AD 631885   Unclassified

Also published in British Jour. Pharmacol. and Chemo-
ther., v. 21: 244-249, Oct. 1963.

When the superior cervical ganglion of the cat was per-
fused with Locke solution, the amount of acetylcholine
released into the perfusate decreased during successive
periods of repetitive stimulation of the preganglionic
nerve. Addition of choline to the perfusion fluid pre-
vented this decrease. Choline also significantly in-
creased ($P < 0.01$) the initial output of acetylcholine.
In contrast, variation of the physostigmine concentra-
tion or of the pCo_2 and pH of the perfusion fluid had no
statistically significant effect ($P < 0.05$) upon the initial
release of acetylcholine.

2405

St. John's U. [Dept. of Physics] Jamaica, N. Y.

BORN CROSS-SECTIONS FOR SELECTED INELASTIC
COLLISIONS OF PROTONS WITH HYDROGEN ATOMS
IN STATES UP TO n = 10, by J. Carew and S. N.
Milford. [1963] [6]p. incl. diagrs. tables, refs.
(AF AFOSR-61-10)   Unclassified

Published in Astrophys. Jour., v. 138: 772-777, Oct.
1, 1963.

Born total cross-sections for inelastic collisions of
protons with excited hydrogen atoms may be derived
approximately from the Born cross-sections for ine-
lastic collisions of electrons with excited hydrogen
atoms. A comparison of the exact and approximate
Born cross-sections for the collisions p + H(ni) →
p + H(n'l'): 1s-2s, 1s-2p, 3s-4p, 3d-4f, shows that they
agree down to energies near the Born maximum. By
using the known electron cross-sections, approximate
Born total cross-sections are calculated for proton
collisions for some of the transitions 1-n'; 2-n'; 3-4,
5; 4-5, 6; 5-6; 10-11. In addition, a simple formula
is given for finding other approximate proton cross-
sections in terms of the approximate electron cross-
sections calculated recently. (Contractor's abstract)

2406

San Andres U., La Paz (Bolivia).

TIME VARIATIONS IN COSMIC RAYS AND RADIO-
SONDE MEASUREMENTS, by I. Escobar. Final tech-
nical rept. June 1963, 105p. (Rept. no. 25) (AFOSR-
J1338) (AF AFOSR-62-395) AD 433133; AD 434540
                                                  Unclassified

This report covers the experimental work performed
on cosmic ray and radiosonde measurements. In the
different selections of this report information based
mainly or completely on data resulting from local ex-
periments is given. In the first two parts, papers
dealing with cosmic ray studies are presented, one
concerning the electromagnetic states of the interplane-
tary space and the other concerning Forbush decreases.

In the third part of the report, the results of the measurements obtained with the radiosonde equipment installed at Ovejuyo, are given.

2407

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

AORTIC DEPRESSOR FIBERS IN THE RAT: AN ELECTROPHYSIOLOGICAL STUDY, by E. M. Krieger and R. F. Marseillan. [1963] [4]p. incl. illus. table, refs. (AFOSR-64-1174) (AF AFOSR-61-60) AD 442990 Unclassified

Also published in Amer. Jour. Physiol., v. 205: 771-774, Oct. 1963.

In 51 rats the distribution of the aortic depressor fibers which travel in the cervical region with the vagus, sympathetic, laryngeal, or as a separate aortic nerve was investigated by recording the action potential or by stimulating these nerves. A separate aortic depressor nerve was found in only 20% of the rats on the left side and in 5% on the right side. In these animals no depressor fibers were identified in the sympathetic trunk but the laryngeal nerves usually still exhibited depressor fiber activity. In those rats with no separate aortic depressor nerve the aortic fibers were present almost equally in the sympathetic trunk and laryngeal nerves, and on both sides of the neck. Only exceptionally was depressor activity found in the vagus trunk, and stimulation elicited depressor instead of pressor effects in 2 out of 12 rats. Optimal stimuli for obtaining hypotensive effects from the aortic depressor fibers were 80-150 per frequency and 1-2-msec duration.

2408

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

EFFECTS OF ADRENAL CORTICOIDS ON VISUAL EVOKED CORTICAL POTENTIALS IN THE CAT, by M. R. Covian, M. C. Lico, and J. Antunes-Rodrigues. [1963] [12]p. (AFOSR-64-1844) (AF AFOSR-61-60) AD 449973 Unclassified

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 146: 81-92, Nov. 1, 1963.

The effect of topically adrenal corticoids on the surface of the cat, in relation to visual evoked cortical potential was studied. Hydrocortisone, desoxicorticosterone acetate, cortisone and aldosterone were tested. The effects were more consistent for hydrocortisone and desoxicorticosterone acetate. Hydrocortisone determined a marked increase of the negative component, the positive one being less affected. Desoxicorticosterone acetate caused a diminution of both components; in general the first component was more affected. An explanation of the results is given in terms of changes in brain intracellular Na concentration and Na ratio.

2409

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

HYPOTHALAMIC CONTROL OF SODIUM CHLORIDE AND WATER INTAKE, by J. Antunes-Rodrigues and M. R. Covian. [1963] [7]p. (AFOSR-64-1845) (AF AFOSR-61-60) AD 449974 Unclassified

Also published in Acta Physiol. Latinoamer., v. 13: 94-100, 1963.

Studies on the 2% NaCl and water intake using the self-selection method were made in 35 adult rats. The cyclical variations of ingestion of both fluids in males and females did not keep correlation with changes in temperature, relative humidity and atmospheric pressure of both liquids was related to estrous period, being more marked for NaCl. Changes in NaCl and water intake were observed during the 10 days following sham operation.

2410

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

ON SOME NEURAL EFFECTS OF CHLORPROMAZINE AND METHAMPHETAMINE, by E. Xavier and C. Timo-Iaria. [1964] [6]p. (AFOSR-64-1846) (AF AFOSR-61-60) AD 449975 Unclassified

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 147: 512-517, Feb. 1, 1964.

The influences exerted by chlorpromazine and methamphetamine on the effects of stimulation of the midbrain reticular formation on a monosynaptic spinal reflex of the cat, were studied. The changes of the reflex were determined before and after microinjections of those drugs directly into the sites of stimulation, and the curves of excitability of the reflex arc were compared. Chlorpromazine shifted the curves to the side of pure facilitation. Methamphetamine turned any effect into pure inhibition. Such changes only occurred during stimulation. Intravenous injection of chlorpromazine depressed the reflex, probably by blocking the afferent fibers of the arc. When methamphetamine was injected intravenously, the reflex underwent prolonged facilitation, that was abolished by severing the spinal cord at L1 or L2.

2411

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

SPECIFIC ALTERATIONS IN SODIUM CHLORIDE INTAKE AFTER HYPOTHALAMIC LESIONS IN THE RAT, by M. R. Covian and J. Antunes-Rodrigues. [1963] [5]p. (AFOSR-64-1847) (AF AFOSR-61-60) AD 449976 Unclassified

Also published in Amer. Jour. Physiol., v. 205: 922-926, Nov. 1963.

Bilateral electrolytic lesions in the hypothalamus of the rat elicited either a decrease or increase in 2% NaCl intake, without a significant change in water ingestion. Lesions placed in the anterior hypothalamus involving supraoptic or paraventricular nuclei, or both, resulted in a conspicuous fall of NaCl intake. The decreased consumption remained to the end of the experiments which in some rats lasted 105 days and was accompanied by a decrease in NaCl urinary output. On the contrary, lesions placed in the central hypothalamus determined a specific increase of NaCl intake together with an augmented urinary excretion. The increased ingestion was permanent and lasted to the end of the experiment.

2412

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

CAROTID OCCLUSION IN THE RAT: CIRCULATORY AND RESPIRATORY EFFECTS, by E. M. Krieger. [1963] [8]p. (AFOSR-64-1848) (AF AFOSR-6I-60) AD 449977   Unclassified

Also published in Acta Physiol. Latinoamer., v. I3: 350-357, 1963.

In the rat the temporary occlusion of both common carotids produced increases in blood pressure, heart and respiratory rates. Symptoms of cerebral ischemia with disappearance of the responses supervened when the occlusions were maintained up to 5-I0 min. The occlusion of the internal carotids produced weaker but similar responses to those observed when the common carotids were occluded. The data are suggestive that in the rat the responses elicited by the occlusion of both common carotids are only partially due to reflex mechanisms (baro and chemoreceptor) from the sinus area.

2413

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

EFFECTS OF STIMULATION OF THE CEREBELLAR CORTEX ON SPINAL MONOSYNAPTIC REFLEXES, by C. Timo-Iaria and J. J. O'Flaherty. [1964] [11]p. incl. diagrs. refs. (AFOSR-66-0989) (AF AFOSR-62-335) AD 634554   Unclassified

Also published in Acta Neurol. Latinoamer., v. I0: 49-59, 1964.

Electrical stimulation of the cerebellar cortex with single pulses preceding the monosynaptic extensor reflex evoked from afferents of the gastrocnemius branches and tibialis nerve, was performed in lightly anesthetized cats. By plotting the effects of the conditioning pulses on the reflex potentials as a function of time, the following patterns were disclosed: (a) From many loci it was possible to stabilize previously oscillating reflex potentials. (b) In several cases the evoked effect was reduced after the first or second stimuli. (c) Inhibition arose from the ipsilateral vermian and contralateral paravermian zones, from ipsilateral

crus II and contralateral crus I, from ipsilateral paramedian lobule and from the ipsilateral dorsal and contralateral ventral paraflocculi. Facilitation was provoked from the symmetric corresponding areas. (d) These influences lasted over 100 msec in most curves but were generally weak. (e) Reciprocal innervation was a definite pattern of such effects.

2414

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

ROLE OF VARIOUS BRAIN STRUCTURES ON PHYSIOLOGICAL FUNCTIONS, by M. R. Covian. Final technical rept. May 1, I963-May I, 1964. June I2, I964, 27p. incl. refs. (AFOSR-64-I272) (AF AFOSR-63-3I1) AD 602786   Unclassified

Summaries of I5 works completed or being studied are presented. These include work in the following fields: (1) Role of the central nervous system on homeostasis; (2) Sensory and motor systems, (3) Neuroendocrinology, (4) Behavioral studies, and (5) Neurochemistry.

2415

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

EFFECTS OF STIMULATION OF THE SEPTAL AREA UPON BLOOD PRESSURE AND RESPIRATION IN THE CAT, by M. R. Covian, J. Antunes-Rodrigues, and J. J. O'Flaherty. [1964] [I4]p. incl. illus. tables, refs. (AFOSR-65-I288) (AF AFOSR-63-3II) AD 6I78I9
                Unclassified

Also published in Jour. Neurophysiol., v. 27: 394-407, 1964.

In cats under chloralose the septal area was electrically stimulated and blood pressure and respiration changes were studied. The most striking finding observed was a fall of blood pressure gradually beginning during stimulation, or after it, and always outlasting the stimulus by 3-5 min. Bradycardia was often a concomitant feature. Changes in respiration consisted in an inhibition either in inspiration or expiration. In a few cases an increase in blood pressure was elicited, but only during the period of stimulation. Several tests indicate that the depressor reaction is due most probably to an inhibition of vasoconstrictor and cardiac accelerating fibers, but a role for vasodilator facilitation cannot be rules out.

2416

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

NEUROGENIC HYPERTENSION IN THE RAT, by E. M. Krieger. [1964] [II]p. (AF AFOSR-63-3II) AD 617820   Unclassified

Also published in Circulation Research, v. 15: 511-521, Dec. 1964.

Several techniques of radical denervation of the sino-aortic depressor areas were tried in order to produce a permanent neurogenic hypertension in the rat. A simple one-stage operation for complete sino-aortic barroreceptor denervation is described. This procedure was used in 140 rats that were then studied for periods up to one year. All the operated animals presented some degree of hypertension. Blood pressure measurements made during the first week showed even then that the rats were hypertensive. This observation suggests that in the rat no latent period for the appearance of neurogenic hypertension is present. Hypertension was permanent in 75% of the rats observed up to one year; blood pressure returned to normal values in the remaining 25%, usually after the third month.

2417

Serendipity Associates, Sherman Oaks, Calif.

RESEARCH ON MECHANISMS FOR THE CONTROL OF STRESS, by E. E. Smith. Final rept. Jan. 31, 1964, 56p. incl. refs. (AFOSR-64-0190) (AF 49(638)1216) AD 432823   Unclassified

Informal, extemporaneous joking and laughing occurs in all groups, although its frequency appears to vary according to the situation and group structure. It is assumed that extemporaneous humor must serve one or more important functions in a group, including stress reduction, or it would not occur, and people would not seem to value it. The interests of this project have been directed toward determining the effects of joking on group interactions and outputs, and the personality attributes and roles of those who do most of the joking. The basic premise investigated is that joking behavior facilitates group interaction and productivity, and that this facilitation is particularly effective when the group is operating under stress.

2418

Sheffield U. Dept. of Biochemistry (Gt. Brit.).

USE OF A PURIFIED BACTERIAL FORMATE DEHYDROGENASE FOR THE MICRO-ESTIMATION OF FORMATE, by P. A. Johnson, M. C. Jones-Mortimer, and J. R. Quayle. [1964] [3]p. incl. diagr. tables. (AFOSR-65-2188) (AF EOAR-64-8) AD 628821   Unclassified

Also published in Biochim. et Biophys. Acta, v. 89: 351-353, 1964.

This communication records a simple method of purification of an NAD+-linked formate dehydrogenase from formate-grown Pseudomonas oxalaticus which enables either a determination of 0.05-0.15μmol of formate or the rate of formation of formate in a reaction system to be made directly.

2419

Sheffield U. Dept. of Fuel Tech. and Chemical Engineering (Gt. Brit.).

COMBUSTION INSTABILITY RESEARCH ON SOLID AND LIQUID PROPELLANT ROCKET MOTORS AT SHEFFIELD UNIVERSITY, by J. Swithenbank. June 1963 [24]p. incl. diagrs. refs. (Technical note no. 1); Rept. no. HIC 22) (AFOSR-5292) (AF EOAR-63-101) AD 419582   Unclassified

Presented at AFOSR Contractor's meeting, Nantucket, Mass, June 1963.

Rocket motor combustion instability has been under investigation. The first phase of this work concerned the high frequency tangential mode of oscillation, in a premixed gaseous fuelled rocket motor. In particular the first tangential travelling mode was studied because this is considered the most destructive mode of instability. The research was extended to cast double base propellants.

2420

Sheffield U. [Dept. of Fuel Tech. and Chemical Engineering] (Gt. Brit.).

INTENTIONAL COMBUSTION OSCILLATIONS IN PROPULSION SYSTEMS, by J. Swithenbank and D. Harris. June 1964, 65p. (Scientific rept. no. 1; Rept. no. HIC 45) (AFOSR-64-2029) (AF EOAR-63-101) AD 608206   Unclassified

The object of this research program is to determine useful applications of oscillatory combustion. In particular the generation of MHD power is suggested by the high ionization obtained in a combustion wave. In the limit, a detonation wave releases all the energy of combustion in the 'oscillation' and maximum temperatures are obtained. If the wave is a travelling tangential mode, theoretical studies suggest that either strong isentropic waves or cyclic detonation waves may be formed. Calculations of the MHD power generation by such waves are presented.

2421

Sheffield U. Dept. of Physics (Gt. Brit.).

PARAMAGNETIC RESONANCE IN RARE EARTH METALS, by J. Popplewell and R. S. Tebble. June 30, 1963, 1v. incl. diagrs. table, refs. (AFOSR-5342) (AF EOAR-62-45) AD 422254   Unclassified

The difference between the g values of paramagnetic metals and those of free ions has been attributed to an interaction between the paramagnetic ions and the conduction electrons. g shifts have been observed in gadolinium metal and several of its alloys; namely gadolinium with yttrium, gadolinium with palladium, and gadolinium woth lutetium. The g shift is generally found to be negative though it may be positive for the dilute alloys with yttrium. There would appear to be some small concentration dependence of the g value and this

together with the positive or negative behavior of the g shift, is examined with respect to the Yosida and Kondo models. In this way the behavior of the g shift can be more readily understood. In order to interpret the resonance measurements, preliminary measurements of susceptibility and magnetization were made. In addition it was necessary to measure lattice parameters since phase diagrams for some of the alloy systems are not available. (Contractor's abstract)

2422

Siena U. Inst. of Medical Pathology (Italy).

ELECTROENCEPHALOGRAPHIC DESYNCHRONIZATION DURING DEEP SLEEP AFTER DESTRUCTION OF MIDBRAIN-LIMBIC PATHWAYS IN THE CAT, by G. Carli, V. Armengol, and A. Zanchetti. [1963] [3]p. incl. diagrs. (AFOSR-J954) (AF 61(052)253) AD 415840   Unclassified

Also published in Science, v. 140: 677-679, May 10, 1963.

Lesions which interrupt the ascending limb of the midbrain-limbic circuit in the cat at different levels, or which even destroy it completely, do not prevent electroencephalographic desynchronization at the beginning of periods of deep sleep, nor do they affect the maintenance of desynchronization throughout the sleep episodes. The pontine mechanisms responsible for these electroencephalographic patterns can apparently exert their influence through ascending pathways other than those directly impinging on the hypothalamus and the limbic system. (Contractor's abstract)

2423

Siena U. Inst. of Medical Pathology (Italy).

EXCITATION AND INHIBITION OF SHAM RAGE BEHAVIOR BY LOWER BRAIN STEM STIMULATION, by E. Bizzi, A. Malliani and others. [1963] [18]p. incl. illus. refs. (AFOSR-64-0092) (AF 61(052)253) AD 431179   Unclassified

Also published in Arch. Ital. Biol., v. 101: 614-631, 1963.

In 60 unanesthetized, acute thalamic cats the medullary and pontine tegmentum was electrically stimulated by means of stereotactically oriented concentric electrodes, and the effect of this stimulation tested on rage behavior. It was shown that both excitation and inhibition of sham rage behavior can reflexly be induced by appropriate electrical stimulation within the reticular formation of the lower brain stem.

2424

Siena U. Inst. of Medical Pathology (Italy).

ASCENDING AFFERENT MECHANISMS MAINTAINING

SHAM RAGE BEHAVIOR IN THE ACUTE THALAMIC CAT, by A. Malliani, E. Bizzi and others. [1963] [16]p. incl. diagrs. refs. (AFOSR-64-0093) (AF 61(052)253) AD 430950   Unclassified

Sixty-five acute thalamic cats have been submitted to different types of electrolytic lesions of the midbrain, aiming at interrupting discretely each of various ascending afferent systems. It is shown that not only section of the medial lemnisci and lateral spino-thalamic tracts, but also interruption of those ascending pathways directly projecting upon the hypothalamus, i.e. Schütz's bundle and the mammillary peduncle system, are without apparent effect on the sham rage behavior of the thalamic cat. Only severe encroachment upon the medial and lateral reticular formation can abolish spontaneous and peripherally evoked rage behavior, although leaving efferent hypothalamic pathways partially viable. There is also a good correspondence between reticular lesions precipitating EEG synchronization and those preventing rate activity.

2425

Siena U. Inst. of Medical Pathology (Italy).

CENTRAL NERVOUS MECHANISMS IN CIRCULATION REGULATION, by C. Bartorelli and A. Zanchetti. Final rept. May 25, 1964, 1v. incl. illus. diagrs. refs. (AFOSR-64-1133) (AF 61(052)253) AD 601731
                Unclassified

Ascending brain stem mechanisms regulating consciousness and emotional behavior have been studied in intact free-moving, and in acute decorticate cats, with attention to hypothalamic role in circulation control.

2426

Siena U. Inst. of Medical Pathology (Italy).

REFLEX REGULATION OF CONSCIOUSNESS AND EMOTIONAL BEHAVIOUR, by M. Guazzi, A. Malliani, and A. Zanchetti. [1964] [17]p. incl. illus. diagrs. refs. (AFOSR-65-0954) (AF 61(052)253) AD 617633
                Unclassified

Also published in Acta Neurochirurg., v. 12: 198-214, 1964.

The afferent modulation of the central nervous mechanisms regulating conscious behavior is discussed, and compared to the effects of afferent and brain stem stimulation on the emotional behavior of diencephalic origin. The electroencephalographic synchronization and sleep induced by stimulating the carotid sinus baroreceptors in encéphale isolé or intact animals is paralleled by the inhibition of the spontaneous sham rage outbursts of the decorticate cat by natural baroreceptive stimulation; on the other hand, the carotid body chemoceptors do not only exert an arousing action, but are also capable of precipitating sham rage fits in the decorticate cat. The rage behavior of the decorticate cat depends, like cortical desynchronization and wakefulness in intact animals, upon a tonic background of ascending reticular activity.

2427

Siena U. Inst. of Medical Pathology (Italy).

[MICROELECTRODE RECORDING OF : LOW HYPO-
THALAMIC EVOKED RESPONSES TO SENSORY STIM-
ULI] Registrazione microelettrodica di resposte lente
ipotalamiche evocate da stimoli sensitivi, by G. Carli,
A. Malliani, and P. Rudomln. [1965] [2]p. (AFOSR-
65-2744) (AF 61(052)253) AD 629279   Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40:
983-984, 1964.

In the current work tungsten microelectrodes were used
to record diencephalic evoked responses in intact cats
under local anesthesia and gallamine immobilization.
The radial nerves were stimulated with single super-
maximal impulses, and light flashes and short clicks
were used to stimulate the optic and acoustic afferent
systems. The morphology of the evoked responses were
generally uniform, consisting of a single negative wave
with a latency of about 20-30 msec, except for the
posterior and lateral hypothalamus, where the negative
wave was preceded by a small positive one and a con-
sequently shorter latent period (about 10 msec). The
evoked responses to somatic, visual, and acoustic
stimuli were similar except for an early negative wave
in the acoustic responses. Thus microelectrode re-
cording of evoked diencephalic activity gave a distribu-
tion and morphology that was much the same as that
observed with monopolar macroelectrodes.

2428

Siena U. Inst. of Medical Pathology (Italy).

[EXTRACELLULAR RECORDING OF DIENCEPHALIC
UNIT ACTIVITY EVOKED BY SENSORY STIMULI]
Registrazione extracalluliare dell'attivita unitaria dien-
cefailca evocata da stimcli sensitivi, by G. Carli, A.
Malliani, and P. Rudomin. [1964] [2]p. (AFOSR-66-
0732) (AF 61(052)253) AD 633286   Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40:
985-986, 1964.

Evoked unit activity was recorded from the posterior
and lateral hypothalamus, supramammilary region,
subthalamic region, and non-specific thalamic nuclei,
but there was no evidence of evoked unit activity in the
anterior hypothalamus and preoptic region.

2429

Siena U. Inst. of Medical Pathology (Italy).

[EFFECTS OF PULMONARY VENTILATION ON THE
CIRCULATORY RESPONSES TO ELECTRICAL STIM-
ULATION OF THE SINOCAROTID NERVE IN THE DE-
CEREBRATE CAT] Effetti della ventilazione polmonare
sulle risposte circolatorie alla stimolazione elettrica
del nervo senocarotico nel gatto decerebrato, by M.
Guazzi. [1964] [5]p. incl. illus. (AFOSR-66-0737)
(AF 61(052)253) AD 632640; AD 633563
                                    Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40:
980-983, 1964.

In the intercollicular decerebrate cat, one of the sino-
carotid nerves was stimulated electrically, and the re-
flex circulatory effects were studied during both spon-
taneous respiration and artificial respiration at various
volumes. When the sinocarotid nerve is stimulated with
intermediate voltage impulses, the responses are of the
hypertensive type even during hyperventilation. This in-
dicates that only a few of the inhibitory pressoceptor fi-
bers are stimulated when a large part of the chemoceptor
component is already involved. Since most of the pres-
soceptor fibers in the sinocarotid nerve of the cat are
excited only by rather high-voltage stimuli, these fibers
probably have a smaller diameter than many fibers of
the chemoceptor type.

2430

Siena U. Inst. of Medical Pathology (Italy).

SOMATIC FUNCTIONS OF THE NERVOUS SYSTEM, by
A. Zanchetti. 1963, 39p. (AF 61(052)253) AD 632647
                                    Unclassified

Also published in Ann. Rev. Physiol., v. 24: 287-324,
1962.

A review is given of research on wakefulness, sleep,
and control mechanisms of the reticular formation.

2431

Siena U. Inst. of Medical Pathology (Italy).

[STIMULATION OF VARIOUS GROUPS OF CUTANEOUS
FIBERS AT DIFFERENT FREQUENCIES IN THE ACUTE
THALAMIC CAT] Stimolazione a varia cadenza di
diversi gruppi di fibre cutanee, nel gatto talamico acuto,
by G. Carli, A. Malliani, and A. Zanchetti. [1964]
[4]p. incl. refs. (AFOSR-66-0788) (AF EOAR-64-41)
AD 633332   Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40:
2158-2161, 1964.

The authors describe the effects of various rates of
stimulation of different size afferent fibers in the super-
ficial radial nerve of the acute thalamic cat. Among
other effects it was found that stimuli combinations that
were able to induce sleep in the animals were unable to
inhibit spontaneous attacks of sham rage.

2432

Siena U. Inst. of Medical Pathology (Italy).

[PRESSURE CHANGES DURING DEEP SLEEP IN CATS
WITH SINOCAROTID AND AORTIC DEAFFERENTA-
TION] Variazioni pressorie durante il sonno profondo
nel gatto con deafferentazione senocarotica e aortica, by
M. Guazzi and A. Zanchetti. [1964] [3]p. incl. table.
(AFOSR-66-1103) (AF EOAR-64-41) AD 639812
                                    Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 2156-2158, 1964.

Blood pressure changes associated with deep sleep in cats were studied before and after sinocarotid and aortic deafferentiation. It was found that both systolic and diastolic pressures fall more markedly in the deafferentiated animals than in those left intact. The animals that had been operated on displayed both a greater absolute decrease in pressures and lower minimal pressure levels. In some of the deafferentiated animals the pressure fell so low that epileptiform activity appeared on the electroencephalograms, causing a return to higher blood pressure levels and arousal of the cats.

2433

Siena U. Inst. of Medical Pathology (Italy).

[PERSISTENCE OF THE HIPPOCAMPAL THETA RHYTHM DURING DEEP SLEEP IN THE CAT FOLLOWING LESIONS OF THE MESENCEPHALIC-LIMBIC SYSTEM] Permanenza del ritmo teta ippocampico durante il sonno profondo dei gatto, dopo lesioni dei sistema mesencefalo-limbico, by G. Carli and A. Zanchetti. [1964] [2]p. (AFOSR-66-1104) (AF EOAR-64-41) AD 639539   Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 2162-2163, 1964.

It has been stated by other investigators that the characteristic theta waves present in the hippocampus of cats during deep sleep are evoked by electrical impulses ascending the mesencephalic-limbic pathways. After making extensive lesions in these pathways, the authors still found a clear theta rhythm in the hippocampus. They conclude that the hippocampal theta activity is caused by impulses arriving at least partially by other than mesencephalic-limbic tracts.

2434

Smithsonian Inst. Astrophysical Observatory, Cambridge, Mass.

STUDY OF ATMOSPHERIC ENTRY AND IMPACT OF HIGH-VELOCITY METEORITES (LARGE-SCALE ELECTRON-PROBE MEASUREMENTS OF METEORITES), by F. B. Riggs, Jr. Final rept. [1963] 95p. incl. illus. tables, refs. (AFOSR-5079) (AF 18(600)-1596) AD 415141   Unclassified

A study was made of the effects of ablation on meteorites by metallurgical methods. In conjunction with the study an electron-probe microanalyzer was designed and constructed.

2435

South Carolina U. [Dept. of Electrical Engineering] Columbia.

MULTIPLE INTERNAL REFLECTIONS IN DIELEC-

TRIC PRISMS, by R. G. Fellers. Final rept. Apr. 1, 1962-May 30, 1963. Aug. 31, 1963, 7p. (AFOSR-5281) (AF AFOSR-62-315) AD 417486   Unclassified

Research concerned the transmission of microwave beams around right angle corners by use of double curvature reflectors, the evaluation of the effect of multiple reflections in a prism device and computation of near zone antenna fields. A pair of dielectric prisms were used as an adjustable directional coupler, an adjustable attenuator, and a duplexing device. An analysis is given for the case of matched interfaces at the surfaces of the prisms. Theoretical derivation of the power transmitted to receivers located at right angles to the transmitter was carried out. Experimental results at wavelengths of 8.5 mm were in very good agreement with the theoretical prediction.

2436

South Carolina U. [Dept. of Electrical Engineering] Columbia.

MEASUREMENTS AT MILLIMETER AND SUBMILLIMETER WAVELENGTHS, by R. G. Fellers. 1960-1963, 6p. (AFOSR-5289) (AF AFOSR-62-315) AD 418157   Unclassified

Also published in IEEE Trans. Instrumentation and Measurement, v. IM-12: 139-141, Dec. 1963. (AFOSR-65-2872).

The development of measurement techniques in the millimeter and submillimeter range has been accelerated by improvements in sources and the development of transmission systems including conventional dominant mode waveguide, TE01 mode circular waveguide, oversized rectangular waveguide and free-space transmission systems with and without beam-guiding techniques.

2437

South Carolina U. Dept. of Electrical Engineering, Columbia.

INTERNAL REFLECTIONS IN DIELECTRIC PRISMS, by R. G. Fellers and J. Taylor. [1964] [4]p. incl. diagrs. refs. (AFOSR-65-1101) (AF AFOSR-63-3) AD 619743   Unclassified

Also published in IEEE Trans. Microwave Theory and Tech., v. MTT-12: 584-587, Nov. 1964.

The prism device is useable as an adjustable bidirectional coupler and as an adjustable attenuator. With coupling set at 3 decibels, it can be used as a hybrid junction. The theoretical calculation of coupling in all directions in the presence of internal reflections is shown. The adaptability of the prism device to a wide variety of functions makes it very useful at the shorter mm wavelengths where the elimination of internal reflections is difficult. The calculations presented here appear applicable in this case.

2438

Southampton U. (Gt. Brit.).

THE REACTION OF TITANIUM HALIDES WITH TERTI-
ARY AMINES, by G. W. [A.] Fowles and R. A. Hoodless.
[1963] [6]p. incl. diagrs. tables, refs. (AFOSR-
J184) (AF EOAR-62-48) AD 400072   Unclassified

Also published in Jour. Chem. Soc., v. 5: 33-38, Jan.
1963.

Titanium(IV) chloride and bromide reacted with tri-
methylamine to give simple adducts TiX_4, NMe_3, that
were monomeric in benzene solution. An excess of
the amine reduced titanium to the tervalent state and
gave the compounds TiX_3, $2NMe_3$; these were also pre-
pared by direct reaction of trimethylamine with the ap-
propriate trihalide. Pyridine also reduced titanium(IV)
halides. Titanium(III) chloride with pyridine or γ-pico-
line gave 1:3 adducts, and with α-picoline a 1:2 adduct.
The spectra of these compounds have been measured
and interpreted. (Contractor's abstract)

2439

Southampton U. (Gt. Brit.).

A STUDY OF THE CHEMISTRY AND STRUCTURE OF
COMPLEX 5-CO-ORDINATION COMPOUNDS, by
G. W. A. Fowles. Final rept. Jan. 1, 1962-Sept. 30,
1964, 8p. (AFOSR-65-0008) (AF EOAR-62-48)
                                      Unclassified

A number of 5-co-ordinate compounds of Ti(III), Ti(IV),
V(III), V(IV), and Mo(V) have been prepared and char-
acterized. A wide range of compounds of these ele-
ments and of Zr, Nb, Ta, Cr, and W have also been
characterized in several oxidation states, with co-ordi-
nation numbers ranging from 4 to 8. In many instances
spectroscopic studies have permitted assignment of un-
ambiguous structures to the complexes.

2440

Southern California U. Dept. of Chemistry, Los Angeles.

SOAP FILMS AND SOME PROBLEMS IN SURFACE
AND COLLOID CHEMISTRY, by K. J. Mysels. [1964]
[8]p. incl. illus. diagrs. refs. (AFOSR-65-0517)
(AF 49(638)309) AD 614293   Unclassified

Also published in Jour. Phys. Chem., v. 68: 3441-
3448, Dec. 1964.

Soap films are a powerful tool for the study of surface
and colloidal phenomena due to a well-defined geome-
try, a simple monolayer structure, and an easily ob-
served behavior. The formation and evolution of rela-
tively thick films are controlled by ordinary hydrody-
namics, without any indication of the existence of rig-
idified aqueous layers near the surface. Thinner films
show the effect of both double-layer repulsion and van
der Waals attractions. These forces balance at a
thickness of the order of 100A. Some problems in the

interpretation of recent measurements of these equilib-
rium thicknesses and some approaches leading to
further information about these forces are discussed.
(Contractor's abstract, modified)

2441

Southern California U. Dept. of Chemistry, Los Angeles.

THE FLUORINATION OF ORGANIC SULFUR COM-
POUNDS, by N. Kharasch, C. M. Buess and others.
Final rept. Sept. 1, 1959-Jan. 31, 1964. July 1964,
6p. (AFOSR-64-1409) (AF 49(638)718)
                                      Unclassified

Research is summarized on (1) methods for the prepa-
ration of sulfenyl fluorides, RSF; (2) properties of re-
lated compounds of the class RSX S(X - Cl, Br, 1, OR,
ONO_2, etc.) which might be useful towards conversions
to fluorine containing compounds; and (3) evaluation of
the literature on the chemistry of sulfenyl fluorides
and related substances, with a view to understanding
the differences in behaviors of different RSX deriva-
tives, where X varies, as above.

2442

Southern California U. Dept. of Electrical Engineering,
Los Angeles.

A SURVEY OF METHODS FOR DYNAMIC SYSTEM
IDENTIFICATION AND RESEARCH IN OPTICAL CO-
HERENCE, by R. B. McGhee, G. O. Young, and R. S.
Macmillan. Final rept. Mar. 1963, 81p. incl. diagrs.
refs. (USCEC rept. 97-101) (AF 49(638)893)
AD 405815   Unclassified

The parameter space approach is believed to represent
a new point of view regarding the general problem of
system identification. The method is restricted only by
the requirement that a parametric model of finite dimen-
sionality must be provided for the system under test.
The parameter space method involves the determination
of transformations defined over a finite dimensional
vector space rather than over a Hilbert space. In addi-
tion to the computational advantages gained by a param-
eter space approach, there is the further advantage
that no special test signals are required as in the Wiener
theory. The model for a nonlinear system can be in-
ferred from normal operating records.

2443

Southern California U. [Dept. of Electrical Engineering]
Los Angeles.

RESEARCH IN COMPUTER DECISION PROCESS, by
B. O. Young and R. McGhee. Final rept. Aug. 1963,
94p. (USCEC rept. no. 98-101; rept. no. EE-27)
(AFOSR-4669) (AF AFOSR-62-69) AD 419695
                                      Unclassified

The report consists of two separate parts representing
two distinct investigations. The first part is concerned

with optimization criteria in system design; the second deals with the identification problem for nonlinear systems.

2444

Southern California U. Dept. of Electrical Engineering, Los Angeles.

RESEARCH IN PLASMA MAGNETOHYDRODYNAMICS, by Z. Kaprielian. Mar. 1963 [16]p. incl. diagrs. (USCEC rept. no. 96-101) (AFOSR-4853) (AF AFOSR-62-112) AD 413768   Unclassified

The research reported here involves theoretical and experimental work in five major areas: (1) Electromagnetic radiation from a dipole in an anisotropic plasma, (2) Plasma diagnostics, (3) Modified P.I.G. discharge hot plasma source, (4) Plasma parametric amplifier, and (5) Measurements of thermal radiation from a highly ionized current carrying plasma. The results of these investigations are reviewed briefly.

2445

Southern California U. [Dept. of Electrical Engineering] Los Angeles.

USE OF ELECTRON PROBES IN THE STUDY OF RECOMBINATION RADIATION, by D. B. Wittry and D. F. Kyser. [1964] [4]p. (AFOSR-65-0175) (AF AFOSR-63-76) AD 611498   Unclassified

Also published in Jour. Appl. Phys., v. 35: 2439-2442, Aug. 1964.

The electron probe microanalyzer was used to study the local variations in recombination radiation from gallium arsenide. The intensity of recombination radiation from different specimens varies by several order of magnitude. Local fluctuations are observed which attributed to surface deformation and to non-uniform distribution of impurities. Within experimental error, the wavelength distribution was indistinguishable from the wavelength distribution from GaAs diodes.

2446

Southern California U. [Dept. of Electrical Engineering] Los Angeles.

METHODS OF QUANTITATIVE ELECTRON PROBE ANALYSIS, by D. B. Wittry. [1964] [24]p. (AFOSR-65-0176) (AF AFOSR-63-76) AD 611499
                                                Unclassified

Presented at Twelfth annual Conf. on X-Ray Analysis, Denver Colo., Aug. 7-9, 1963.

Also published in X-Ray Anal., v. 7: 395-418, 1964.

In electron probe analysis quantitative results can be achieved with only pure elements as standards provided (1) the analysis conditions are carefully selected,

(2) the observed intensities can be corrected to obtain the primary intensity actually produced in the specimen, and (3) the relationship of the primary intensity and concentration can be calculated. While present methods of making some of the corrections require improvement, and a 'universal' theory for relating the primary x-ray intensities to the concentrations still does not exist, the success achieved with this approach indicates that it should be used to the fullest extent before resorting to calibration curves. Moreover, as information is accumulated, the number of cases requiring the use of calibration curves should diminish, so that eventually it may be possible to perform quantitative analysis in any system with only pure elements as standards.

2447

Southern California U. [Dept. of Electrical Engineering] Los Angeles.

RESEARCH IN OPTICAL COHERENCE AND NONLINEAR ESTIMATION THEORY, by G. O. Young, C. Giese, and R. S. Macmillan. Final rept. Dec. 1963, 116p. (USCEC rept. no. 102-101; rept. no. EE-34) (AFOSR-64-1141) (AF AFOSR-63-188) AD 601764
                                                Unclassified

The theory developed in this report applies to any type of process or source. It is shown that the coherence properties of electromagnetic waves bear a direct relationship to their information carrying capacity. A number of examples are worked out of the coherence properties of monochromatic and polychromatic waves emitted by either point sources or extended objects. The effect of aperture limitation on the coherence properties of the image of the above sources is also investigated. Part II is concerned with the estimation of the dynamic states of a nonlinear differential equation which is quasi-linear in the vector function $x = f(x)$. To demonstrate the nonlinear estimation procedure, an algorithm was programmed for a digital computer which solves the equations for estimation of the dynamic states of an unguided reentry space vehicle.

2448

Southern California U. Dept. of Electrical Engineering, Los Angeles.

RESEARCH IN OPTICAL COHERENCE, by R. S. Macmillan, G. O. Young and others. Final rept. Dec. 1964, 76p. incl. diagrs. refs. (USCEC rept. no. 102-101-1; rept. no. EE-34-1) (AFOSR-65-1690) (AF AFOSR-64-188) AD 624108   Unclassified

The research reported is presented in three parts. Part 1: The normalized mutual coherence function is defined and applied. Its maximization is equivalent to maximizing information transfer through an optical system. Part 2: The covariance matrix for both a back-scattered electromagnetic process and a spacial noise process is formulated. Part 3: An exact derivation is presented for the binary detection system.

2449

Southern California U. Dept. of Electrical Engineering,
Los Angeles.

FERMI LEVEL POSITION AT METAL-SEMICONDUC-
TOR INTERFACES, by C. A. Mead and W. G. Spitzer.
[1964] [4]p. incl. diagr. table, refs. (AFOSR-64-1351)
(AF AFOSR-64-496) AD 444142   Unclassified

Also published in Phys. Rev., v. 134: A713-A716,
May 4, 1964.

The position of the Fermi level at a metal-semiconduc-
tor interface relative to the conduction band has been
found to be a constant fraction of the semiconductor
band gap for all but 3 of the 14 group IV or III-V semi-
conductors studied. In all cases, the position was es-
sentially independent of the metal work function. This
general result is not inconsistent with the limited
theories of surface state energies now available. The
three exceptional cases can be understood in terms of
a first-order perturbation to the surface state energies
correlated with a similar perturbation observed in the
energy gap at the (111) zone edge. Experiments are
also reported on Ga(As-P) alloys, and two II-VI materi-
als showing distinctly different behavior.

2450

Southern California U. Dept. of Electrical Engineering,
Los Angeles.

CONDUCTION BAND MINIMUM OF CdTe, by W. G.
Spitzer and C. A. Mead. [1964] [5]p. incl. diagrs. refs.
(AFOSR-64-1352) (AF AFOSR-64-496) AD 444143
                                        Unclassified

Also published in Jour. Phys. and Chem. Solids, v.
25: 443-447, 1964.

The spectral dependence of the photovoltaic effect for
Au-n-type CdTe surface barrier cells is measured for
photon energies near the CdTe intrinsic absorption
edge at 298, 77, and 5°K. The results are viewed in
terms of phonon assisted direct absorption, phonon
assisted exciton creation at a previously proposed lat-
tice defect site, and indirect optical transitions. The
data appears to favor the third mechanism although the
second one is not ruled out as a possibility. The val-
ues for the direct transition energy gap obtained at the
different temperatures compare favorably with those
given by other work.

2451

Southern California U. Dept. of Electrical Engineering,
Los Angeles.

TRANSVERSE PARAMAGNETIC EFFECT IN AN IR-
REVERSIBLE TYPE II SUPERCONDUCTOR, by
M. A. R. Leblanc. [1964] [2]p. incl. diagrs.
(AFOSR-64-1584) (AF AFOSR-64-496) AD 446346
                                        Unclassified

Also published in Phys. Ltrs., v. 10: 260-261, June
15, 1964.

A paramagnetic moment or net excess flux parallel to
an external field H_a occurs in a hard superconductor
when a transport current transverse to the field is in-
troduced after cooling through T_c in the presence of the
field. This phenomenon which is referred to as the
"transverse paramagnetic effect", is described in the
present note.

2452

Southern California U. [Dept. of Electrical Engineering]
Los Angeles.

JOINT SERVICES ELECTRONICS PROGRAM. Final
rept. Sept. 1, 1963-Sept. 1, 1964 [65]p. incl. refs.
(AFOSR-65-0390) (AF AFOSR-64-496) AD 612039
                                        Unclassified

The research efforts of this program are summarized.
The solid state phase has consisted of investigations on
semiconductors, magnetism, imperfections in crystals,
and superconductivity. The applied electromagnetics
and plasma research includes the problem of electro-
magnetic wave propagation. In the field of information
sciences, control systems, bioelectronics, and coding
theory have been investigated.

2453

Southern California U. Dept. of Electrical Engineering,
Los Angeles.

ON THE THEORY OF LINEAR PASSIVE SYSTEMS, by
J. Meixner. [1964] [19]p. (AFOSR-65-0914)
(AF AFOSR-64-496) AD 617595   Unclassified

Also published in Arch. Rational Mech. and Anal., v.
17: 278-296, 1964.

The main theorems on linear passive systems are
quoted. Then 2 subclasses, the relaxation systems of
the first and of the second kind, are defined and various
properties of them are derived. Sufficient conditions
are given that a linear passive system with a stimulus
which is a harmonic function for t > 0 will have a
response which approaches a harmonic function for
$t \rightarrow \infty$. Finally the representation theorems are derived
for vector-valued linear passive systems.

2454

Southern California U. Dept. of Electrical Engineering,
Los Angeles.

A GEOMETRICAL STUDY OF TRANSMITTED REFER-
ENCE COMMUNICATION SYSTEM, by R. M. Gagliardi.
[1964] [6]p. incl. diagrs. table. (AFOSR-65-2118)
(AF AFOSR-64-496) AD 627544   Unclassified

Also published in IEEE Trans. Commun. Tech., v.
COM-12: 118-123, Dec. 1964.

A study is presented of a general transmitted reference (TR) system, with the primary objective of finding bounds on these restrictions. It is based upon geometrical considerations using the fact that a transmitted reference system can be described by vectors in, and linear transformations upon, an N-dimensional Euclidean space. In this way it can be shown, for example, that the dimension of the transmitting channel must be greater than that of the space of carrier signals for unique operation. It is shown that a TR system always operates with at least a 3-dB poorer signal-to-noise ratio than that of an ideal locally generated reference system, with the bound increasing to 6 dB if the transmitter is power limited, and gets progressively worse as the transmitter power to noise-power ratio decreases below 0 dB. Some curves are plotted to show the relationships quantitatively.

2455

Southern California U. Engineering Center, Los Angeles.

RESEARCH ON RAREFIED GASDYNAMICS AND PLASMADYNAMICS, by R. L. Chuan. Summary rept. Sept. 1962-Aug. 1963. Dec. 1963, 77p. incl. illus. diagrs. tables, refs. (USCEC rept. no. 93-101) (AFOSR-84-0565) (AF AFOSR-63-55) AD 436451   Unclassified

The work of the project is summarized under the following topics: (a) Hypersonic low density wakes, including free-molecule theory two-dimensional wakes and experiments in low density wakes; (b) Impact pressure at low density (theoretical treatment and experiments); (c) magnetohydrodynamic waves in a flowing plasma; and (d) free molecule electrostatic probe.

2456

Southern California U. Engineering Center, Los Angeles.

ON THE TOTAL FORCE OF ELASTIC SCATTERING - NEUTRAL PARTICLES AND PERFECT CRYSTAL, by E. Beder. [1964] [38]p. incl. diagrs. tables, refs. (AFOSR-85-1154) (AF AFOSR-83-55) AD 818826
Unclassified

Also published in Surface Sci., v. 1: 242-279, 1964.

Quantum and classical-mechanical microscopic theory is developed for the total force on a cold solid plane surface resulting from the elastic scattering of an incident uniform cold beam of particles. The solid is a semi-infinite project dielectric crystal. The particles are neutral noninteracting mass points. The particle-solid interaction potential is that of physical adsorption normal to the surface, with a small sinusoidal perturbation along the surface to represent crystal nuclei. The theory is applied to a 2-dimensional periodic crystal problem. Two limiting cases of purely specular reflection are found at high and low particle energies. Between these limits the forces are computed in a limited number of cases for the incident on LiF. The theory presented is then compared to classical theory.

2457

[Southern Methodist U., Dallas, Tex.]

VELOCITY OF COMPRESSIONAL WAVES IN VARIOUS MINERALS AT PRESSURE TO 10 KILOBARS, by G. Simmons. [1984] [5]p. (AF AFOSR-83-418) AD 439289
Unclassified

Also published in Jour. Geophys. Research, v. 89: 1117-1121, Mar. 15, 1964.

The velocity of compressional waves in several minerals, as a function of pressure to 10 kb, has been measured. Data for single-crystal microcline suggest that measurements of elastic constants should be made under hydrostatic pressure for all material not of gem quality. Velocities for some rocks with high calcium content suggest a correction to the velocity-density-mean atomic weight relationship of Birch for content of CaO.

2458

Southern Research Inst., Birmingham, Ala.

A STUDY OF THE DIFFUSIVITY OF IRON IN LIQUID SLAGS, by E. B. Dismukes. Final rept. Jan. 1, 1959-Dec. 31, 1962. Feb. 4, 1963, 28p. (Rept. no. SRIB-573701954-XIII) (AFOSR-4493) (AF 49(638)523) AD 609459   Unclassified

The self-diffusion coefficients of iron and calcium in silicate melts were measured. These data and comparable data in the published literature do not fully support some of the currently held theories of the structure of silicate melts. The diffusivity of iron, for example, seems to have a surprisingly high energy of activation, and further information is needed concerning the diffusivity. The exchange of iron between solid metal and molten iron silicate was also studied. This phenomenon creates difficulties in determining the diffusivity of iron when it is necessary, as in this study, to use the metal iron as the material of construction for diffusion vessels.

2459

Southwest Research Inst., San Antonio, Tex.

NONDESTRUCTIVE EVALUATION OF METAL FATIGUE, by J. W. Fogwell, F. Kusenberger, and W. L. Donaldson. Mar. 29, 1963, 30p. (AFOSR-5149) (AF 49(638)1147) AD 411481   Unclassified

A nondestructive testing device was developed to monitor the progress of fatigue growth in a rod-type fatigue specimen stress cycled in direct tension. The technique developed was that of using a Hall-effect element to monitor the perturbations in the magnetic field at the surface of the specimen when the specimen was magnetized. Both longitudinal and radial flux orientations in the specimen are possible with the system developed under this contract. Typical inspection records

taken with longitudinal flux orientation are presented. Preliminary tests were made to determine the repeatability and sensitivity of the system.

2460

Southwest Research Inst., San Antonio, Tex.

NONDESTRUCTIVE EVALUATION OF METAL FATIGUE, by F. N. Kusenberger, J. R. Barton, and W. L. Donaldson. Mar. 13, 1964, 78p. (AFOSR-64-0668) (AF 49(638)1147) AD 600277   Unclassified

This report includes a discussion of the magnetic techniques and magnetic inspection - fatigue tester equipments. The design and construction of new electronics for use with the Bismuth Hall probes is summarized. Results obtained from fatigue tests to determine the required stress level for reasonable life are analyzed, and photographs of many fracture surfaces are included. A brief summary of the nondestructive detection of fatigue damage using the magnetic inspection equipment is given.

2461

Space Sciences, Inc., Waltham, Mass.

EXTENSION OF THE MOTT-SMITH METHOD FOR A ONE-DIMENSIONAL SHOCK WAVE, by H. Salwen, C. E. Grosch, and S. Ziering. [1964] [10]p. incl. diagrs. tables. (AFOSR-64-0920) (AF 49(638)1228) AD 439872   Unclassified

Also published in Phys. Fluids, v. 7: 180-189, Feb. 1964.

A method has been developed for adding an arbitrary number of additional terms to the two-term Mott-Smith distribution function for a one-dimensional shock wave and a calculation has been carried out, for a monatomic gas of Maxwellian molecules, with a three term distribution function. For weak shocks, the calculated reciprocal shock thicknesses are within 2% of the Navier-Stokes results. This is a substantial improvement over the Mott-Smith results which, for the same force law, are 15 to 30% too low.

2462

Sperry Rand Corp. Univac Div., Blue Bell, Pa.

MULTI-LIST SYSTEM: ADDITIONAL NOTES ON A STUDY INTO AUTOMATIC ATTRIBUTE GROUP ASSIGNMENT, by E. G. Fossum, G. Kaskey and others. Mar. 27, 1964 [33]p. incl. diagrs. tables. (Technical rept. no. 3) (AFOSR-64-2476) (AF 49(638)1194) AD 609709   Unclassified

This report continues analyses into the automatic attribute assignment program of the Multi-List System using as basic data a large nonrandom sample of 38,402 DDC (formerly ASTIA) documents. The assignment program now has been extended to include the 599 most frequently used descriptors in the sample

file; this comprises those used 72 times or more in the 38,402 documents and represents slightly more than 10% of the 5,577 different descriptors in the sample. In addition, a start has been made into analyzing the characteristics of the pair association included among these 599 descriptors and some preliminary statistical data are contained in the report.

2463

Sperry Rand Corp. Univac Div., Blue Bell, Pa.

MULTI-LIST SYSTEM: FINAL NOTES ON A STUDY INTO AUTOMATIC ATTRIBUTE GROUP ASSIGNMENT, by E. G. Fossum, G. Kaskey and others. Oct. 1, 1964 [37]p. incl. tables. (Technical rept. no. 4) (AFOSR-64-2477) (AF 49(638)1194) AD 609710   Unclassified

The report completes the analyses into the automatic attribute group assignment program of the Multi-List System. The array of attribute groups is subject to updating (adjustment) as new documents add new descriptor associations to the file. An analysis is made of the use of the attribute groups as a means of entry to 'lists' of documents having several descriptor ranges in common. It is concluded that the technique is not an efficient method of list organization for a document retrieval application; in general, the objective of combining two or three exclusive descriptors into a 'super-key' cannot be achieved. Some of the data characteristics which a file must possess for this method to be efficient are described.

2464

Stanford Research Inst., Menlo Park, Calif.

THE STUDY OF THE ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS. PHASE I: THE MEASUREMENT OF ACOUSTIC ADMITTANCE, by G. M. Muller. Final rept. May 14, 1964, 116p. (AF 49(638)565) AD 443188   Unclassified

A reflected-pulse method for measuring the real part of the complex acoustic admittance ratio of an almost perfectly reflecting surface is described. The method involves sending an acoustic pulse down a long tube terminated by the surface to be investigated, and observing the pressure-time profile of the pulse before and after reflection. A comparison experiment in which the tube is terminated by a perfect reflector allows the separation of changes in the pulse spectrum due to reflection by the surface of interest from those due to the tube. Small finite-amplitude effects do not interfere with the measurement.

2465

Stanford Research Inst., Menlo Park, Calif.

THE STUDY OF THE ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS, PHASE II: A STUDY OF COMBUSTION

INSTABILITY AND ITS DEPENDENCE ON PROPEL-
LANT COMBUSTION CHARACTERISTICS, by L. A.
Dickinson and E. L. Capener. Final rept. May 14,
1964, 20p. incl. diagrs. tables. (AF 49(638)565)
AD 442392   Unclassified

A range of propellants was studied to learn how unsta-
ble burning characteristics were affected by (1) burning
rate catalysts, (2) oxidizer type, and (3) particle size
variation in the oxidizers and metallic fuels. The stud-
ies were carried out in a 5-in. diam by 40-in. long
motor which was pulsed using a well-proven triggering
technique. As the nominal burning rates of the propel-
lants increased, the burning propellants became less
increased, the burning propellants became less respon-
sive to pulsing. This was manifested by a steady in-
crease in chamber pressure at which instability would
not occur even at pressures as high as 2400 psi. In
addition, it was noted that the peak-to-peak pressure
amplitude of the oscillation steadily decreases as the
burning rate increases. Also of interest to propellant
formulators was the observation that incorporation of
coarse oxidizer and coarse spherical aluminum powder
lowered the pressure level at which instability could be
triggered in a propellant.

2466

Stanford Research Inst., Menlo Park, Calif.

INVESTIGATION OF CRYSTAL GROWTH PROCESSES,
by W. J. Fredericks, F. E. Rosztoczy, and J.
Hatchett. Jan. 1963, 24p. (AFOSR-4731) (AF 49(638)-
999) AD 407600   Unclassified

A method for purification of KCl by anion and cation
exchange was developed. The crystalline product of
the purification process and single crystals grown from
this product were evaluated. This investigation shows
that the method produces crystals superior to those cur-
rently available commercially.

2467

Stanford Research Inst., Menlo Park, Calif.

THE KNOWLEDGE ANALYST: AN APPROACH TO
STRUCTURING MAN-MACHINE SYSTEMS, by K. H.
Schaeffer, J. B. Fink and others. Feb. 1963, 132p.
incl. illus. tables, refs. (AFOSR-4490) (AF 49(638)-
1020) AD 297432   Unclassified

In an attempt to evolve a general method for systems
analysis, the matrix-network approach for the analysis
of complex man-machine systems is presented. This
approach consists of seven steps which show how a
system can be structured and how mathematical models
of systems aspects can be incorporated into the over-
all analysis. However, some of these steps involve,
besides formal rules, the judgment of a knowledgeable
analyst. To delve deeper into this judgment function,
various logical, methodological, and psychological as-
pects concerning this function are discussed by differ-
ent authors. On the basis of these discussions the

principal author develops requirements which must be
met by successful approaches to the structuring of
complex systems.

2468

Stanford Research Inst., Menlo Park, Calif.

APPLICATIONS OF THE BEHAVIORAL SCIENCES TO
RESEARCH MANAGEMENT: AN INITIAL STUDY IN
THE OFFICE OF AEROSPACE RESEARCH, by H. M.
Vollmer. Nov. 1964, 84p. incl. diagrs. tables, refs.
(AFOSR-64-2555) (AF 49(638)1028) AD 609356
                                       Unclassified

The method of the study included collection of data by
use of personal interviews, a standard written question-
naire, and review of management records. Findings on
research organization substantiate the importance of
protecting the integrity of research activities and to dif-
ferentiate them from development, to maintain a par-
ticipatory style of leadership, to support methods to
translate research findings into rapid utilization, and to
assure a sense of continuity in laboratory structure and
research programs. Findings on the evaluation of re-
search productivity point out methods to measure the
quality of research products, as well as quantity. Find-
ings on the recruitment, retention, and utilization of
scientists suggest the importance of freedom in the con-
duct of research as a general incentive related to re-
productivity and job satisfaction.

2469

Stanford Research Inst., Menlo Park, Calif.

ADAPTATIONS OF SCIENTISTS IN FIVE ORGANIZA-
TIONS: METHODOLOGY AND TECHNICAL APPENDIX,
by H. M. Vollmer, T. R. LaPorte and others. May
1964, 123p. incl. tables, refs. (Technical rept.,
phase II b) (AFOSR-65-1307) (AF 49(638)1028)
AD 621253   Unclassified

This investigation is part of a continuing study of the
adaptations of scientists in different organizational con-
texts. The investigation consists of 2 aspects: (1) the
effect on the individual of constraints that research or-
ganizations impose; and, (2) the consequences on the or-
ganization produced by individual research on the part
of these scientific employees. Five government organi-
zations were studied. Data was collected by interviews
and questionnaires. Response data is presented in tabu-
lar form and copies of the questionnaire and interview
guides are included. In analyzing the data, the dynam-
ics of interaction within each organization were as-
sessed and generalizations were made about the type of
organization studied.

2470

Stanford Research Inst., Menlo Park, Calif.

ADAPTATIONS OF SCIENTISTS IN FIVE ORGANIZA-
TIONS: A COMPARATIVE ANALYSIS, by H. M.

Vollmer, T. R. LaPorte and others. May 1964, 124p. incl. diagrs. tables, refs. (Tec' l rept., phase 11b) (AFOSR-65-1308) (AF 49(' ·)1028) AD 619529
Unclassified

A study of adaptations of scientists in five different organizations is presented. Case studies are presented for (1) a university research organization, (2) an aerospace industrial research organization, (3) a nuclear research and development laboratory, (4) a federal government defense research organization, and (5) an independent non-profit research organization. Organizations are compared with respect to such criteria as degree of professionalization, degree of bureaucratization, degree of industrialization, recruitment and displacement, incentives, socialization, status advancement, and research entrepreneurship. An image of what might be called a model professional organization is presented.

2471

Stanford Research Inst., Menlo Park, Calif.

SUDDEN IONOSPHERIC DISTURBANCES AND THE PROPAGATION OF VERY-LOW-FREQUENCY RADIO WAVES. PART II: WHISTLER TAPE ANALYSIS AND INSTRUMENT DEVELOPMENT, by A. L. Whitson and E. T. Pierce. Final rept. Apr. 1963, 60p. (AF 49-(638)1081) AD 410598
Unclassified

The effects of a sudden ionospheric disturbance (SID) on atmospheric noise were investigated using data collected during the International Geophysical Year and the International Cooperation Year. During an SID, atmospheric noise is enhanced at frequencies above 12 and below 1 kc. At frequencies between 3 and 10 kc, it is decreased. A simple device that records the ratio of atmospheric noise at 27 kc over noise at 6 kc was developed as an SID detector. Measurements made during SIDs show that the present method of reporting sudden enhancements of atmospheric (SEA) at 27 kc results in many reports of SIDs when the disturbances were probably due to other causes, notably local thunderstorms. These spurious reports are avoided by the use of a ratio meter.

2472

Stanford Research Inst., Menlo Park, Calif.

FUNDAMENTAL RESEARCH IN SUPPORT OF VELA-UNIFORM, by G. E. Duvall and R. C. Alverson. May 31, 1964, 155p. (AF 49(638)1086) AD 442254
Unclassified

Research is reported on: Thermodynamics of uniaxial compression in an elastic-plastic solid; Stress relaxation in quartzite derived from shock wave measurements; Plane and spherical waves in a compressible plastic-relaxing medium; Spherical waves in an incompressible plastic-relaxing medium; Measurements of compression modulus in uniaxial strain; and Spherical waves in elastic-plastic media.

2473

Stanford Research Inst., Menlo Park, Calif.

OXIDATION OF UNSATURATED HYDROCARBONS, by D. E. Van Sickle and F. R. Mayo. Final rept. Oct. 1, 1961-Sept. 30, 1963. Jan. 10, 1964, 6p. (AFOSR-64-0025) (AF 49(638)1102) AD 429761   Unclassified

Research effort for the last two years has been directed principally toward product studies of low temperature, liquid-phase olefin oxidations. Pure hydrocarbons were utilized where possible, azo initiators employed, and conversions limited to 5%. An attempt has been made to correlate the hydroperoxide produced with the remaining products found and to assign relative rates for two chain propagation reactions. A secondary effort was the study of autocatalysis in oxidation. Cyclopentene was chosen as a model compound, since its oxidation mechanism is the simplest of the olefins studied. Decomposition and initiating properties of hydroperoxides also received attention.

2474

Stanford Research Inst., Menlo Park, Calif.

VISUAL-INFORMATION PROCESSING IN THE BEETLE LIXUS, by J. C. Bliss. [1964] [6]p. (AFOSR-64-1697) (AF 49(638)1112) AD 448261
Unclassified

Also published in Proc. 1962 Ojai Symposium on Neural Theory and Modeling, Calif. (Dec. 4-6, 1962), Stanford U. Press, 1964, p. 325-330. (AFOSR-64-1694)

Results discussed in this report showed that the partial reactions of ommatidial pairs are summed. Also, an analysis of sequential decisions showed that the probability of a decision in a given direction being followed by a decision in the same direction was greater than the zero-order probability in that direction. Electrical recordings from the eye of the beetle Lixus were made of the electroretinogram and of spike potentials. The ERG study demonstrated the nonlinearity of the response and suggested a 13-msec pure delay followed by a simple lag network with corner frequency at 4 cps as an approximation for the response to small changes in light intensity. Spike potentials were obtained from a single cell that fired with an increase in light intensity.

2475

Stanford Research Inst., Menlo Park, Calif.

EXPERIMENTS ON VISUAL RESPONSES IN INSECTS, by J. C. Bliss, W. D. Chapple and others. Final rept. Oct. 14, 1963-Oct. 14, 1964. Nov. 1964, 64p. (AFOSR-65-0042) (AF 49(638)1112) AD 610426
Unclassified

The optomotor response of the milkweed bug Oncopeltus Fasciatus Dallas (Hemiptera) is described. Measured optical constants of compound eyes are also described and possible explanations are offered of certain observed phenomena relating to the appearance of 'multiple image planes' behind the array of lenslets. The

cyclic discharge of motor fibers in response to decreases in light intensity is discussed. Stimulation experiments suggest that response is triggered by a simple phasic discharge in the connectives. A physiological model incorporating the results of these experiments is described.

2476

Stanford Research Inst., Menlo Park, Calif.

SHOCK SENSITIVITY OF LOW DENSITY GRANULAR EXPLOSIVES, by M. W. Evans, C. M. Ablow and others. [1963] [17]p. (AFOSR-J1016) (AF 49(636)-1124) AD 417663   Unclassified

Also published in Internat'l. Conf. on Sensitivity and Hazards of Explosives Research and Development Establishment, London (Gt. Brit.), Sept. 1-3, 1963.

The structure of shocks which initiate a detonation wave in low density granular explosives is discussed. Measurements of shock sensitivity of ammonium perchlorate, PETN, and mixtures of the two are reported. The data are interpreted in terms of temperature of the receiver on the basis of two simple models: the equilibrium temperature of a locking solid assuming complete compaction, and the temperature of the interstitial gas at the moment the shock has entered the receiver.

2477

Stanford Research Inst., Menlo Park, Calif.

LOCAL SEISMIC MONITORING AT SHOAL, by W. H. Westphal and G. S. Brink. Nov. 15, 1963. 16p. (Technical rept. no. 5) (AF 49(636)1205) AD 425386
Unclassified

Local seismic monitoring was initiated in the Fairview Peak region of Nevada in July 1961, and was conducted at intervals until Oct. 21, 1963, five days prior to Shoal event. Since that date, continuous measurements have been made at three seismograph stations located approximately 10 km northeast, 10 km southwest, and 3.4 km west of ground zero. Preliminary evaluation of data accumulated through Nov. 11, indicates that the majority of these events had their epicenters in the Fairview Peak fault block; this was true also of the majority of recorded preshot events.

2478

Stanford Research Inst., Menlo Park, Calif.

SEISMIC AFTERSHOCK INVESTIGATIONS—PROJECT VELA UNIFORM, FISK, MISSOURI, EARTHQUAKE OF 3 MARCH 1963, by A. L. Lange and W. H. Westphal. Aug. 1963, 16p. (Technical rept. no. 3) (AF 49(636)-1205) AD 414677   Unclassified

The aftershock monitoring is reported following the Fisk, Missouri, earthquake of Mar. 3, 1963 which had an instrumentally determined epicenter approximately 13 km southeast of Fisk, Missouri, and 27 km east of Poplar Bluff in the southeast corner of the state.

2479

Stanford Research Inst., Menlo Park, Calif.

SEISMIC AFTERSHOCK INVESTIGATIONS—PROJECT VELA UNIFORM JUAB VALLEY, UTAH, EARTHQUAKE OF 7 JULY 1963, by W. H. Westphal. Oct. 1963, 20p. (Technical rept. no. 4) (AF 49(636)1205) AD 426421
Unclassified

One proposed method of detecting and locating the source of a clandestine underground explosion is the monitoring of post-event seismic noises (aftershocks) produced by the explosion. The basic premise of post-event seismic monitoring is that aftershocks from earthquakes and underground explosions have different characteristics. The specific objectives are: (1) to determine the characteristics of earthquake and explosion-induced aftershock sequences, (2) to study the relationship of the foci of earthquake aftershocks to the focus of the primary earthquake, and (3) to improve methods of data analysis and interpretation of the results of aftershock monitoring.

2460

Stanford Research Inst., Menlo Park, Calif.

DIFFERENTIAL SEISMIC CALIBRATION IN ON-SITE INSPECTION, by W. H. Westphal and S. Rubin. Aug. 1963, 19p. (Technical rept. no. 1) (AF 49(636)1225) AD 414652   Unclassified

Seismic calibration of an area required the occurrence of a seismic event, either an explosion or earthquake in the vicinity of the unkonwn event at a known location and of sufficient size to be detectable at several teleseismic network stations that also recorded the original unknown event. The purpose of the calibration event is to determine the error of the epicenter location of an unidentified event; this error is caused by differences in the velocities of seismic waves from the source of the event to each detecting seismic station. The calibration event must be located close to the epicenter of the unknown event so that the calibration signal follows approximately the same paths as the original event signal. The calibration signal must be detected by at least three different stations to calculate a precise correction.

2461

Stanford Research Inst., Menlo Park, Calif.

SYLLABUS OF ON-SITE INSPECTION. Second edition, July 1963, 1v. (AF 49(636)1225) AD 411536
Unclassified

On-site inspection of unidentified seismic events consists of observations and measurements in a defined geographic area. It will be directed toward distinguishing between underground or underwater nuclear explosions and other seismic events. A determined violator of a nuclear test ban by cleverly concealing his nuclear test activities might believe he has reduced the likelihood of identification to zero. However, so long as an inspection is undertaken there is always a possibility that the clandestine test could be exposed.

2482

Stanford U. [Dept. of Aeronautics and Astronautics]
Calif.

BUCKLING TESTS ON THIN CIRCULAR CYLINDRICAL
SHELLS HEATED ALONG AN AXIAL STRIP, by B.
Ross, J. Mayers, and A. Jaworski. June 1963, 63p.
(SUDAER no. 163) (AFOSR-5420) (AF 49(638)223)
AD 424060   Unclassified

The results of buckling tests on circular cylinders
heated along axial strips are presented and discussed.
Calculations of critical temperature based upon the
small deflection theory for thin circular cylindrical
shells are included, and a comparison is made between
theoretical and experimental results. Cylinders heated
along axial strips of given widths have a theoretically
predicted behavior which corresponds reasonably well
to the behavior obtained by experiment. Curves are
included showing the variation of critical temperature
with respect to heated axial strip width.

2483

Stanford U. [Dept. of Aeronautics and Astronautics]
Calif.

STUDIES IN HYPERSONIC FLOW THEORY, by M.
Van Dyke. Final rept. Feb. 1963, 6p. (AFOSR-4785)
(AF 49(638)965) AD 408349   Unclassified

This study included: Effects of nose bluntness on a
slender body; Flow past inclined blunt bodies; Unsteady
hypersonic flow theory; Viscous effects on blunt bodies;
Irreversible processes in dilute gases; Blunt bodies at
low Reynolds number; Vortical layer on an inclined
cone; and Interaction of entropy and boundary layer.

2484

Stanford U. Dept. of Aeronautics and Astronautics,
Calif.

A STATISTICAL INTERPRETATION OF THERMODY-
NAMICS OF IRREVERSIBLE PROCESSES IN DILUTE
GASES, by J.-P. Gutraud. Sept. 1963, 131p. incl.
refs. (SUDAER no. 169) (AFOSR-5513) (AF 49(638)-
965) AD 426078   Unclassified

A simplified theory is proposed which fulfills the
following requirement: The Boltzmann equation is
not solved, even approximately, but used only to supply
the minimum information required to compute the trans-
port coefficients. This work is a systematic develop-
ment originally planned as a thorough investigation of
mixtures of polyatomic gases under the so-called dilute
gas approximation, with inclusion of chemical kinetics,
as well as an investigation of a variety of macroscopic
descriptions for mixtures, of which, however, only the
two extremes are studied.

2485

Stanford U. [Dept. of Aeronautics and Astronautics]
Calif.

HYPERSONIC VISCOUS FLOW NEAR THE STAGNATION
STREAMLINE OF A BLUNT BODY: I. A TEST OF
LOCAL SIMILARITY, by H. C. Kao. [1964] [6]p. incl.
diagr. table, refs. (AFOSR-65-0597) (AF 49(638)965)
AD 613915   Unclassified

Also published in AIAA Jour., v. 2: 1892-1897, Nov.
1964.

The flow near the stagnation streamline of a blunt body
is often analyzed by using the approximation of local
similarity, which reduces the equations of motion to a
system of ordinary differential equations. This scheme
is equivalent to truncating at 1 term a power-series ex-
pansion of the flow variables from the stagnation point,
neglecting backward influence. The accuracy of such
a truncation is examined in this paper. The principal
assumption is that the Navier-Stokes equations are valid.
In addition, it is assumed that the validity of the first
truncation can be evaluated by comparing it with the
second. The conclusion is that the usual assumption of
local similarity is remarkably accurate for predicting
flow quantities near the stagnation streamline. (Con-
tractor's abstract)

2486

Stanford U. [Dept. of Aeroanutics and Astronautics]
Calif.

HYPERSONIC VISCOUS FLOW NEAR THE STAGNA-
TION STREAMLINE OF A BLUNT BODY: II. THIRD-
ORDER BOUNDARY-LAYER THEORY AND COMPARI-
SON WITH OTHER METHODS, by H. C. Kao. [1964]
[9]p. incl. diagrs. refs. (AFOSR-65-0598) (AF 49(638)-
965) AD 613916   Unclassified

Also published in AIAA Jour., v. 2: 1898-1906, Nov.
1964.

It is shown in Part I that the assumption of local simi-
larity is very accurate for predicting flow quantities
near the stagnation streamline of a blunt body. Here
that assumption is used to calculate the third-order
boundary-layer approximation in this region. The cal-
culation is also made using viscous-layer approximation
and direct integration through the shock wave. Com-
parisons are made to evaluate the relative applicability
of these three approaches. It is found that third-order
boundary-layer theory is valid in the range from inter-
mediate to very high Reynolds numbers, but fails at low
Reynolds number. (Contractor's abstract, in part)

2487

Stanford U. Dept. of Aeronautics and Astronautics,
Calif.

A UNIFORMLY VALID SOLUTION FOR THE FLOW
OVER AN INCLINED CONE USING THE METHOD OF

MATCHED ASYMPTOTIC EXPANSIONS, by A. G. Munson. Apr. 1964, 46p. incl. diagrs. refs. (SUDAER no. 187) (AFOSR 64-1056) (AF 49(638)1274) AD 603154   Unclassified

The problem of flow over a circular cone inclined slightly to a uniform stream is solved using the technique of matched asymptotic expansions. The outer expansion is equivalent to Stone's solution of the problem. The inner expansion, valid in a thin layer near the body, represents Ferri's vortical layer. The solution to first order in angle of attack so obtained is uniformly valid everywhere in the flow field. In the second-order expansion an additional nonuniformity appears near the leeward ray. This defect is removed by inspection. The first-order solution is in agreement with that of Cheng, Woods, Bulakh and Sapunkov. Formulas are given that may be used to render Kopal's numerical result uniformly valid to second order in angle of attack. A uniformly valid solution restricted to the hypersonic small-disturbance approximation is also given. (Contractor's abstract)

2488

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

A NUMERICAL EXPERIMENT WITH DISCRETE-VORTEX APPROXIMATION, WITH REFERENCE TO THE ROLLING UP OF A VORTEX SHEET, by H. Takami. May 1964, 26p. (AFOSR-64-1292) (AF 49-(638)1274) AD 602789   Unclassified

In view of the criticism against the idea of approximating a real vortex sheet by a row of discrete vortices in an inviscid fluid, the rolling up of a vortex sheet studied by Westwater is reexamined. By means of a simple numerical computation, it is shown that strong randomization of the vortices takes place near the tip of the sheet in contrast to Westwater's previous computation. The same approximation is applied also to some other vortex sheets of similar kind. The distribution of vortices becomes irregular in every case and the 'discrete-vortex approximation' does not seem to give a detailed picture of the behavior of the original continuous sheet. The equations of motion of vortices is seen to be unstable with respect to the initial data.

2489

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

A GENERALIZED METHOD FOR TREATING SINGULAR PERTURBATION PROBLEMS, by A. H. Nayfeh. June 1964, 55p. incl. refs. (SUDAER no. 193) (AFOSR-64-1306) (AF 49(638)1274) AD 600083   Unclassified

Some of the existing methods of treating singular perturbation problems are studied, and a generalized method for solving such problems is developed. The generalized method was applied to a restricted three-body problem and to a general second-order linear ordinary differential equation with a turning point of arbitrary order. The results of the latter are used in

obtaining the asymptotic expansions of the eigenvalues and eigenfunctions of a second-order linear equation with two turning points of arbitrary order. A special case of the eigenvalue problem is the Graetz problem. It arises in finding the temperature distribution of a fluid with constant properties having a parabolic velocity profile which enters suddenly into a round tube whose wall is kept at a different constant temperature. (Contractor's abstract)

2490

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

THE CIRCLE AT LOW REYNOLDS NUMBER AS A TEST OF THE METHOD OF SERIES TRUNCATION, by M. Van Dyke. Oct. 1964, 14p. incl. diagrs. refs. (SUDAER no. 211) (AFOSR-64-1832) (AF 49(638)1274) AD 612411   Unclassified

A semi-analytical scheme of successive approximations is described for treating elliptic differential equations. As an extreme test of the method, it is applied to incompressible viscous flow past a circular cylinder. For the Oseen equations the first approximation is found analytically and the second numerically. The results for drag and eddy formation appear to approach the true solution satisfactorily. For the Navier-Stokes equations only the first approximation was calculated, giving drag that agrees only qualitatively with experiment. (Contractor's abstract)

2491

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

INTERACTION OF THE ENTROPY AND BOUNDARY LAYERS ON A BLUNTED WEDGE, by S. Nadir. Dec. 1964, 110p. (SUDAER no. 212) (AFOSR-65-0057) (AF 49(638)1274) AD 464830   Unclassified

A systematic analytical study is made of the interaction of the entropy layer and the laminar boundary layer over a certain blunted semi-infinite wedge in hypersonic viscous flow. The analysis is carried out by constructing the asymptotic solution of the exact problem in the double limit of large Reynolds number and of large distance downstream compared with the nose radius. The resulting singular perturbation problem involving the entropy and boundary layers as the regions of nonuniformity, is treated by the method of matched asymptotic expansions. The asymptotic solution for the limit of large Reynolds number is carried to second order. This comprises the basic inviscid flow, the first-order boundary layer, the flow due to the displacement thickness of the first-order boundary layer, and the second-order boundary layer.

2492

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

THE INTERACTION OF TURBULENCE WITH RAPID UNIFORM SHEAR, by H. K. Moffatt. Aug. 1965, 41p. (SUDAER no. 242) (AFOSR-65-1795) (AF 49(638)1274) AD 628298   Unclassified

The linear inviscid response of an initially weak random velocity perturbation to a uniform shearing motion is analyzed, first in terms of the individual Fourier components of the perturbation field, then in terms of the development of its spectrum tensor. This analysis reveals that the dominant contribution, both to the disturbance energy and to the Reynolds stress generated comes ultimately from eddies having a cylindrical structure, the axes of the cylinders being parallel to the shear force. The results are relevant to two aspects of turbulent shear flow: (1) the equilibrium structure of a small turbulent 'parcel' of fluid subjected to persistent almost uniform shear, and (2) the structure of the 'large eddies' which derive their energy directly from the shearing of the mean flow.

2493

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

A NON-LINEAR MODEL STUDY OF THE THERMAL BUCKLING OF THIN ELASTIC SHELLS, by N. J. Hoff. Nov. 1963, 22p. incl. diagrs. (SUDAER no. 173) (AFOSR-64-0888) (AF 49(638)1276)   Unclassified

Analysis of the simple model proposed yields equilibrium curves in agreement with those obtained by other investigators for axially compressed thin-walled circular cylindrical shells. A rigorous calculation of the stability of the equilibrium of the model indicates that the snap-through phenomenon can be entirely absent when an imperfect shell is heated in a perfectly rigid testing machine. When the testing machine is sufficiently elastic, snap through will occur. (Contractor's abstract, in part)

2494

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

THE EFFECT OF RESTRICTING BUCKLE DEPTH IN CIRCULAR CYLINDRICAL SHELLS REPEATEDLY COMPRESSED TO THE BUCKLING LIMIT, by W. H. Horton and S. C. Durham. Nov. 1963 [15]p incl. illus. diagrs. tables. (SUDAER no. 174) (AFOSR-64-0889) (AF 49(638)1276) AD 432763   Unclassified

The reduction in critical buckling load for a thin-walled cylindrical shell which occurs under repeated compression is a function of the depth to which the buckle is permitted to develop. It shows that a nickel cylinder whose R/t is of the order of 400 does not experience any load reduction on repeated load when the buckle depth never exceeds the thickness of the shell, and that

buckle depths which are equal to or greater than 2.5t give the same results as are obtained in unrestricted buckling. It proves, too, that by using the method of buckle restriction it is possible to cause a cylindrical shell to buckle uniformly over its entire length. (Contractor's abstract)

2495

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

REPEATED BUCKLING OF CIRCULAR CYLINDRICAL SHELLS AND CONICAL FRUSTA BY AXIAL COMPRESSIVE FORCES, by W. H. Horton and S. C. Durham. Nov. 1963, 19p. incl. illus. diagrs. tables. (SUDAER no. 175) (AFOSR-64-0890) (AF 49(638)1276) AD 439013   Unclassified

The results are reported of a series of tests made to determine the buckling behavior of circular cylinders and conical shells under repeated axial compression. It is shown that if the only restriction placed on buckle depth is that buckle development is such that no permanent gross strain results after load removal, then the buckle load progressively falls with repeated application until a constant lower bound is reached. This effect is considered to be due to the formation of plastic hinges along the edges of the buckles.

2496

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

BUCKLING OF AXIALLY COMPRESSED CIRCULAR CYLINDRICAL SHELLS AT STRESSES SMALLER THAN THE CLASSICAL CRITICAL VALUE, by N. J. Hoff and L. W. Rehfield. May 1964, 27p. incl. diagrs. (SUDAER no. 191) (AFOSR-64-1037) (AF 49(638)1276) AD 603153   Unclassified

Closed-form solutions are given of the linear Donnell equations defining the buckling of thin-walled circular cylindrical shells subjected to uniform axial compression. In addition to the classical simple support conditions requiring the vanishing of the radial displacement, the axial bending moment resultant, the axial additional stress and the circumferential displacement, three other, equally justifiable, simple support conditions are defined and studied in the case of the semi-infinite shell. Two of them yield buckling stresses amounting to about one-half the classical critical stress.

2497

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

LOW BUCKLING STRESSES OF AXIALLY COMPRESSED CIRCULAR CYLINDRICAL SHELLS OF FINITE LENGTH, by N. J. Hoff. July 1964, 37p. incl. diagrs. (SUDAER no. 192) (AFOSR-64-1317) (AF 49-(638)1276) AD 614928   Unclassified

Exact solutions are derived for the classical differential equations defining the deformations of axially compressed thin-walled circular cylindrical shells. The end conditions along the circular edges are assumed as the vanishing of (1) the radial displacement; (2) the longitudinal bending moment; (3) the variation in the axial normal stress, and (4) the circumferential membrane shear stress. Under these conditions of simple support the critical value of the uniformly distributed axial normal stress is one-half the classical critical value. (Contractor's abstract)

2498

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

THE EFFECT OF THE EDGE CONDITIONS ON THE BUCKLING OF THIN-WALLED CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION, by N. J. Hoff. Aug. 1964, 23p. (SUDAER no. 205) (AFOSR-64-1724) (AF 49(638)1276) AD 608203   Unclassified

Presented at Eleventh Internat'l. Cong. of Applied Mechanics, Munich (Germany), Aug. 30-Sept. 5, 1964.

A summary is presented of recent closed-form as well as numerical solutions of the buckling problem of thin-walled circular cylindrical shells subjected to uniform axial compression. The ratio of the critical stress to the classical value of the critical stress has been calculated for nine different combinations of boundary conditions. The minimal values of the buckling stress ratios are for rigid end fixation and 0.5 for simple supports, while in the case of free ends the buckling stress ratio can be very small. The large effect on the buckling stress of small changes in the boundary conditions is proposed as one of the reasons for the large scatter in the results of buckling experiments.

2499

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

BUCKLING OF CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION, by N. J. Hoff and T.-C. Soong. Aug. 1964, 78p. (SUDAER no. 204) (AFOSR-64-1725) (AF 49(638)1276) AD 608204   Unclassified

The buckling stress of axially compressed thin-walled circular cylindrical shells of finite length is derived from the classical small-deflection equations for nine possible combinations of edge support conditions. It turns out that the effect upon the critical stress of the length-to-diameter ratio of the shell is small except in some cases when the shell is very short. On the other hand, changes in the details of the edge support can lead to reduction factors of 1/2 or less to be applied to the classical value of the critical stress.

2500

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

AUTOMATED DERIVATION AND INTEGER REPRESENTATION OF TOTAL POTENTIAL DIFFERENTIAL EQUATION EXPANSIONS FOR ASSUMED TRIGONOMETRIC SERIES WITH AN APPLICATION TO THE POST-BUCKLING BEHAVIOR OF CIRCULAR CYLINDRICAL SHELLS, by W. A. Madsen, L. B. Smith, and N. J. Hoff. July 1964, 63p. (SUDAER no. 201) (AFOSR-64-1726) (AF 49(638)1276) AD 608205
Unclassified

In this paper, algorithms are presented for deriving a set of nonlinear algebraic equations with the aid of a digital computer. The equations are then stored by means of an integer representation. A Newton-Raphson algorithm for solving the integerform equations is also presented. The method is illustrated by re-deriving the solution for post-buckling behavior of thin-walled circular cylindrical shells under axial compression. The time required for computations is short; with a Burroughs B5000 computer the total potential expression was derived in approximately two minutes; and the major stable portion of the load-shortening curve was found in ten minutes.

2501

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

LINEARIZED THEORY OF TWO-DIMENSIONAL RADIATING GAS FLOW BY A MOMENT METHOD, by P. Cheng. Apr. 1964, 12p. (SUDAER no. 188) (AFOSR-64-1002) (AF 49(638)1280) AD 602684
Unclassified

The author first lists the hydrodynamic equations for the three-dimensional time-dependent flow. This is followed by a discussion of the approximate radiation-transport equations. Finally, the linearized equations for two-dimensional steady flow are obtained.

2502

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

TWO-DIMENSIONAL RADIATING GAS FLOW BY A MOMENT METHOD, by P. Cheng. [1964] [3]p. incl. refs. (AFOSR-65-0029) (AF 49(638)1280) AD 611345
Unclassified

Also published in AIAA Jour., v. 2: 1662-1664, Sept. 1964.

Since the governing equations for multidimensional radiating gas flow are of a complicated integro-differential form, no reasonably simple solutions exist which are valid for the whole range of optical thickness. The problem is especially acute for multidimensional flow problems. Using a scheme of approximation known as the moment method, a system of differential equations

has been obtained for one-dimensional flow problems. In this note the technique is applied to multidimensional radiating-gas-flow problems. Hydrodynamic equations for three-dimensional time dependent flow are given, and the exact transport equation is approximated by a finite number of moment equations.

2503

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

STAGNATION EQUILIBRIUM LAYER IN NONEQUI-LIBRIUM BLUNT-BODY FLOWS, by R. J. Conti. [1964] [3]p. incl. diagrs. (AFOSR-65-0277) (AF 49-(638)1280) AD 611347　Unclassified

Also published in AIAA Jour., v. 2: 2044-2046, Nov. 1964.

In 1962, Swigart introduced a novel technique for analyzing inviscid perfect gas flows over blunt-bodies in hypersonic flight. The present investigation makes use of this technique to study nonequilibrium flows, and in this paper attention is drawn to the equilibrium layer that exists near the body.

2504

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

[THERMAL HEATING OF THIN-WALLED CIRCULAR CYLINDRICAL SHELLS] Flambement thermique des coques cylindriques circulaires à parois minces, by N. J. Hoff. [1964] [28]p. incl. illus. diagrs. refs. (AF AFOSR-62-146)　Unclassified

Published in High Temperatures in Aeronautics; Proc. Symposium held in Turin to celebrate the 50th anniversary of the Laboratorio di Aeronautica, Politecnico di Torino (Italy) (Sept. 10-12, 1962), ed. by C. Ferrari. Milano, Tamburini Editore, 1964, p. 315-342.

The thermal buckling of thin-walled circular cylindrical shells is studied in 3 principal sections. In the first section the possibility of buckling action is examined under one gradient temperature across a surface. The second section describes the buckling caused by heat-treatment of one axial gradient, and the third section describes the buckling caused by one azimuthal gradient. The results from the experiments are compared to the theories.

2505

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

LIFTING-LINE THEORY AS A SINGULAR PERTURBA-TION PROBLEM, by M. Van Dyke. [1964] [14]p. incl. diagrs. refs. (SUDAER no. 165) (AFOSR-5343) (AF AFOSR-63-96) AD 426471　Unclassified

Also published in Archiwum Mechaniki Stosowanej, v. 3: 601-614, 1964.

The method of matched asymptotic expansions, recently developed for treating singular-perturbation problems, is applied to the flat unswept lifting wing of high aspect ratio. This yields a simplified equivalent of Prandtl's lifting-line theory, with the solution of an integral equation replaced by quadratures. The next approximation is calculated in general terms. Specific application is made to cusped, lenticular, elliptic, and rectangular planforms, and comparison drawn where possible with previous work. Additional non-uniformities at tips and other discontinuities are described, and procedures outlined for their correction.

2506

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

HIGHER APPROXIMATIONS IN BOUNDARY-LAYER THEORY, PART 3. PARABOLA IN UNIFORM STREAM, by M. Van Dyke. [1964] [15]p. (AFOSR-64-1940) (AF AFOSR-63-96) AD 450321　Unclassified

Also published in Jour. Fluid Mech., v. 19: 145-149, 1964.

The classical laminar boundary layer on a parabolic cylinder is calculated using the Blasius series, with modifications to improve convergence, and supplemented by an asymptotic expansion valid far downstream from the nose. The flow due to displacement thickness is thereby found with sufficient accuracy to permit evaluation of its second-order effect upon the boundary layer near the stagnation point. The skin friction and heat transfer are found to be reduced there by both displacement and curvature.

2507

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

THE VORTICAL LAYER ON AN INCLINED CONE, by A. G. Munson. [1964] [19]p. incl. diagrs. refs. (AFOSR-65-0920) (AF AFOSR-63-96) AD 616204　Unclassified

Also published in Jour. Fluid Mech., v. 20: 625-643, 1964.

The problem of flow over a circular cone inclined slightly to a uniform stream is solved using the technique of matched asymptotic expansions. The outer expansion is equivalent to Stone's solution of the problem. The inner expansion, valid in a thin layer near the body, represents Ferri's vortical layer. The solution to first order in angle of attack so obtained is uniformly valid everywhere in the flow field. In the second-order expansion an additional non-uniformity appears near the leeward ray. This defect is removed by inspection. The first-order solution is in agreement with

that of Cheng, Woods, Bulakh and Sapunkov. Formulas are given that may be used to render Kopal's numerical result uniformly valid to second order in angle of attack.

2508

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

A METHOD OF DATA ACQUISITION AND SYSTEM CONTROL TRHOUGH TIME SHARING OF MIXED INPUTS, by B. Brentnall and W. H. Horton. Feb. 1963, 33p. (SUDAER no. 147) (AFOSR-5094) (AF AFOSR-63-138) AD 405931 Unclassified

In recent years, the demand for more versatile, remotely readable measuring devices has caused us to progress, for example, from the simple mechanical extensometer to the electrical resistance wire gage and from the purely mechanical dial gage to the variable differential transformer pick up. Instruments of this type—transducers—have a common property, viz., they transform some particular physical behavior into an electrical signal or change thereof.

2509

Stanford U. [Dept. of Biological Sciences] Calif.

ELECTRICAL RESPONSES FROM DUALLY INNER-VATED TACTILE RECEPTORS ON THE THORAX OF THE CRAYFISH, by D. Mellon, Jr. [1963] [12]p. (AFOSR-64-0542) (AF AFOSR-62-147) AD 436163 Unclassified

Also published in Jour. Exper. Biol., v. 40: 137-148, 1963.

Electrophysiological recordings have been obtained from tactile receptors which occur in shallow pits on the crayfish carapace. Controlled mechanical stimulation has established that each receptor is innervated by a pair of sensory neurons. One of these neurons responds when the receptor is moved anteriorly, and the partner cell responds to displacement in the opposite direction. The receptors are sensitive to motion of the fluid medium in which they are immersed, and they may provide the animal with a means for determining the speed and direction of water currents.

2510

Stanford U. [Dept. of Biological Sciences] Calif.

SOMA POTENTIALS AND MODES OF ACTIVATION OF CRAYFISH MOTONEURONS, by K. Takeda and D. Kennedy. [1964] [17]p. (AFOSR-65-0046) (AF AFOSR-62-147) AD 455020 Unclassified

Also published in Jour. Cellular and Compar. Physiol., v. 64: 165-181, Oct. 1964.

The modes of activation of efferent neurons which innervate flexor muscles through the third root of the third abdominal ganglion have been studied by dual

penetration of their somata. In the 'motor giant' neuron there is normally only passive electrotonic spread of impulses into the soma from distant active areas in the axon, and the polarization of the soma membrane does not affect the events in the root axon. The somata of monopolar non-giant neurons which supply axons to one third root are found on both sides of the third ganglion, and also in the fourth ganglion on the heterolateral side to the root of exit. The action potential recorded in these somata shows three components. One is associated with invasion toward the soma, a second corresponds to the impulse in the main axon and the third represents activity in axon branches which are the site of the presynaptic endings.

2511

Stanford U. [Dept. of Biological Sciences] Calif.

RECEPTIVE FIELD ORGANIZATION AND RESPONSE PATTERNS IN NEURONS WITH SPATIALLY DISTRIB-UTED INPUT, by D. Kennedy and D. Mellon, Jr. [1964] [14]p. incl. refs. (AFOSR-65-0299) (AF AFOSR-63-334) AD 611997 Unclassified

Also published in Proc. 1962 Ojai Symposium on Neural Theory and Modeling, Calif. (Dec. 4-6, 1962), 1964, p. 400-413.

The majority of central interneurons which respond to tactile stimulation of the dorsal abdomen in crayfish serve more than one abdominal segment; a given sensory field is thus represented many times centrally but in varying combinations with other fields. The usual pattern of peripheral connection with these multisegmental interneurons is one in which incoming afferent fibers in each ganglion synapse in the segment of entry with the interneuron, but also pass anteriorly for one or more segments and make accessory synaptic contacts with the same interneuron in other ganglia. Such accessory connections are also sometimes made in the posterior direction, but they are always weaker. The receptive field of the interneurons is therefore capable of broad summation, but it is at the same time fractionated into segmental subareas which have local entry to the interneuron and hence short reflex delays.

2512

Stanford U. Dept. of Biological Sciences, Calif.

INTRACELLULAR RECORDING FROM PHOTORECEP-TOR NEURONS IN THE EYES OF A NUDIBRANCH MOLLUSC (HERMISSENDA CRASSICORNIS), by J. Barth. [1964] [6]p. (AFOSR-65-0300) (AF AFOSR-63-334) AD 612244 Unclassified

Also published in Compar. Biochem. and Physiol., v. 11: 311-315, 1964.

Intracellular records obtained from retinal neurons of nudibranch eyes show both excitation and inhibition of impulse discharge upon appropriate photic stimulation, as well as the slow potential changes associated with these events. Evidence is presented that the action potentials originate at some distance from the soma and

do not invade it in a retrograde fashion. The presence of synaptic inhibition is demonstrated, but the additional phenomenon of primary inhibition observed in other molluscs has not been established. (Contractor's abstract)

2513

Stanford U. Dept. of Chemistry, Calif.

THERMODYNAMIC PROPERTIES OF NONPOLAR MIXTURES OF SMALL MOLECULES, by P. J. Flory and A. Abe. [1964] [3]p. incl. tables. (AFOSR-64-2199) (AF 49(638)1341) AD 452348 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3563-3565, Sept. 5, 1964.

The treatment of n-paraffin hydrocarbons and their mixtures presented in Jour. Amer. Chem. Soc., v. 86: 3507 and 3515, 1964, can be recast in a form which appears to be generally applicable to liquid solutions, irrespective of the size and shape of the molecular species provided that they are not hydrogen bonded or highly polar. Here, a preliminary comparison is made of theory with experiment for several representative binary mixtures of small, approximately spherical molecules.

2514

Stanford U. [Dept. of Chemistry] Calif.

FACTORS INVOLVED IN THE STABILITY OF CYCLOPROPANES, by R. H. Eastman. Final technical rept. Oct. 1, 1961-Sept. 30, 1963 [15]p. (AFOSR-64-0843) (AF AFOSR-62-116) AD 438396 Unclassified

The following dissertations are summarized: A study of electronic effects on a ring-chain equilibrium; Evidence against conjugation effects in phenylcyclopropanes; and Valence bond isomerization in the bicyclo (3.1.0) hexene series.

2515

Stanford U. [Dept. of Chemistry] Calif.

CONJUGATION EFFECTS IN PHENYLCYCLOPROPANES, by A. L. Goodman and R. H. Eastman. [1964] [4]p. (AFOSR-64-0934) (AF AFOSR-62-116) AD 439976 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 908-911, 1964.

The ultraviolet absorption spectrum of phenylcyclopropane has previously been interpreted as evidence that the cyclopropane ring electrons interact with those of the benzene ring to form a conjugated system. It has now been shown, using rigid model compounds, that the steric relationship between the cyclopropane and benzene rings is of little consequence spectroscopically.

2516

Stanford U. Dept. of Chemistry, Calif.

CONFIGURATION OF THE POLY-(DIMETHYLSILOXANE) CHAIN. I. THE TEMPERATURE COEFFICIENT OF THE UNPERTURBED EXTENSION, by J. E. Mark and P. J. Flory. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-64-1492, pt. 1) (AF AFOSR-62-131) AD 445929 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 138-141, Jan. 20, 1964.

The temperature coefficient $d \ln \langle r^2 \rangle_0/dT$ of the unperturbed mean-square end-to-end distance for poly-(dimethylsiloxane) calculated from precise determinations of stress-temperature coefficients for cross-linked networks is $0.78 \ (\pm 0.06) \times 10^{-3}$ deg^{-1}. According to the change of the intrinsic viscosity with temperature, determined on athermal solutions of the linear polymer in a low molecular weight dimethylsiloxane fluid, $d \ln \langle r^2 \rangle_0/dT = 0.71 \ (\pm 0.13) \times 10^{-3}$ deg^{-1}, in good agreement with the former value. (Contractor's abstract)

2517

Stanford U. Dept. of Chemistry, Calif.

CONFIGURATION OF THE POLY-(DIMETHYLSILOXANE) CHAIN. II. UNPERTURBED DIMENSIONS AND SPECIFIC SOLVENT EFFECTS, by V. Crescenzi and P. J. Flory. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1492, pt. 2) (AF AFOSR-62-131) AD 445929 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 141-146, Jan. 20, 1964.

Intrinsic viscosities of poly-(dimethylsiloxane) fractions, $M = 0.55$ to 1.2×10^6, have been determined at the θ-point in two solvents: (1) methyl ethyl ketone at 20° and (2) a 1:2 mixture of C_8F_{18} and $CCl_2F \cdot CCl_2F$ at 22.5°. In (1), $[\eta]_\theta/M^{1/2} = 7.8 \times 10^{-4}$ (with $[\eta]_\theta$ in dl g^{-1}) in close agreement with previous results in other solvents which, like (1), have cohesive energy densities (CED) exceeding that of the polymer. In (2), for which the CED is less than for the polymer, $[\eta]_\theta/M^{1/2} = 10.6 \times 10^{-4}$. The ratios $\langle r^2 \rangle_0/nl^2$ deduced from these results are 6.3 and 7.7 compared with 3.3 calculated for free rotation. (Contractor's abstract)

2518

Stanford U. Dept. of Chemistry, Calif.

CONFIGURATION OF THE POLY-(DIMETHYLSILOXANE) CHAIN. III. CORRELATION OF THEORY AND EXPERIMENT, by P. J. Flory, V. Crescenzi, and J. E. Mark. [1964] [7]p. incl. diagrs. table, refs. (AFOSR-64-1492, pt. 3) (AF AFOSR-62-131) AD 445929 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 146-152, Jan. 20, 1964.

The characteristic ratio $\langle r^2 \rangle_0/nl^2$ for poly-(dimethyl-siloxane) has been calculated by Ising lattice methods using the trans-gauche rotational isomeric state model as a convenient device for introducing various bond conformations with appropriate statistical weights. Steric interactions between nonbonded atoms must exclude successive gauche rotations of opposite sign for the pair of bonds on either side of a silicon atom; coulombic repulsions of O atoms may largely suppress the similar conformation about O. Bond rotations cannot, therefore, be treated as independent. These inferences from the structure of the siloxane chain are confirmed by experimental values of the characteristic ratio.

2519

Stanford U. [Dept. of Chemistry] Calif.

THE TEMPERATURE COEFFICIENT OF THE POLY-DIMETHYLSILOXANE CHAIN CONFIGURATION FROM SWELLING EQUILIBRIUM MEASUREMENTS, by J. E. Mark. [1964] [4]p. (AFOSR-64-1494) (AF AFOSR-62-131) AD 445931   Unclassified

Also published in Jour. Phys. Chem., v. 68: 1092-1095, May 1964.

The temperature dependence of the degree of swelling of polydimethylsiloxane (PDMS) networks in equilibrium with an athermal solvent is used to determine the temperature coefficient of the unperturbed dimensions of the polymer chains comprising the network.

2520

Stanford U. Dept. of Chemistry, Calif.

THE CRYSTALLIZATION OF POLYMETHYLENE COPOLYMERS: MORPHOLOGY, by J. B. Jackson and P. J. Flory. [1964] [3]p. (AFOSR-64-1797) (AF AFOSR-62-131) AD 449256   Unclassified

Also published in Polymer, v. 5: 159-161, 1964.

The morphology of a series of melt-crystallized, random copolymers of CH_2 units with small mole percentages of CHR co-units, where R = nC_3H_7 or CH_3, was investigated. At concentrations greater than 2% n-C_3H_7 and 5.9% CH_3 co-unit, spherulites characteristic of the homopolymer are not evident even at 450 X magnification under the polarizing microscope. The absence of spherulites is attributed to the growth of crystallites in which a given copolymer chain may participate only once, leading to a suppression of lamellar crystal growth. (Contractor's abstract)

2521

Stanford U. Dept. of Chemistry, Calif.

THE CONFIGURATION OF THE POLYOXYMETHYL-ENE CHAIN, by P. J. Flory and J. E. Mark. [1964] [11]p. (AFOSR-64-1798) (AF AFOSR-62-131) AD 449073   Unclassified

Also published in Die Makromolekulare Chemie, v. 75: 11-21, 1964.

The polyoxymethylene chain (POM) is discussed in terms of trans and gauche rotational states and is compared with polyethylene (PE) and poly-(dimethylsiloxane) (PDMS). Examination of distances between non-bonded atoms and groups in various conformations suggests dispersion interactions between O and CH_2 as being primarily responsible for preference for the gauche states; coulombic interactions also favor the gauche conformation, but should be comparatively small. Gauche rotations of opposite sign in the pair of bonds adjoining a CH_2 group are effectively precluded by steric interactions of CH_2 groups separated by four bonds.

2522

Stanford U. Dept. of Chemistry, Calif.

STATISTICAL THERMODYNAMICS OF CHAIN MOLECULE LIQUIDS. I. AN EQUATION OF STATE FOR NORMAL PARAFFIN HYDROCARBONS, by P. J. Flory, R. A. Orwoll, and A. Vrij. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-2190) (AF AFOSR-62-131) AD 452369   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3507-3514, Sept. 5, 1964.

A partition function is formulated for chain molecule liquids using a model consisting of a linear sequence of segments endowed with hard sphere type repulsive potentials and soft attractions of unspecified character. The intermolecular energy is represented as varying inversely with the volume over the comparatively small range of volume of the liquid. Account is taken of intermolecular constraints on the segments by expressing the number of external degrees of freedom per segment as 3c where c (< 1) enters as a parameter. In this respect the formulation follows recent treatments based on the cell model, use of which is avoided. A reduced equation of state $\tilde{p} = \tilde{p}(\tilde{T}, \tilde{v})$ is derived. (Contractor's abstract, in part)

2523

Stanford U. Dept. of Chemistry, Calif.

STATISTICAL THERMODYNAMICS OF CHAIN MOLECULE LIQUIDS. II. LIQUID MIXTURES OF NORMAL PARAFFIN HYDROCARBONS, by P. J. Flory, R. A. Orwoll, and A. Vrij. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-2191) (AF AFOSR-62-131) AD 452369   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3515-3520, Sept. 5, 1964.

The partition function and equation of state of the preceding paper are reformulated for mixtures of homologous chain molecules. Thermodynamic properties of mixtures of n-alkanes are interpreted according to relationships thus derived. The excess volumes, always negative for these systems, are readily interpolated from the volumes of the pure components with the aid of the reduced equation of state. This scheme is formally equivalent to the Brønsted principle of congruence as it applies to the volume.

2524

Stanford U. Dept. of Electrical Engineering, Calif.

FREQUENCY TRANSLATION OF AN He-Ne LASER'S OUTPUT FREQUENCY BY ACOUSTIC OUTPUT COUPLING INSIDE THE RESONANT CAVITY, by A. E. Siegman, C. F. Quate and others. [1964] [2]p. incl. diagr. (AFOSR-65-0107) (AF AFOSR-63-323) AD 455981   Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 1-2, July 1, 1964.

The effectiveness of phonon scattering of a laser beam has been greatly increased by placing the scattering medium inside a laser resonant cavity. This technique makes separate but coherently related beams available at 3 different frequencies, from a single laser. If required, nearly full intensity can be obtained in the secondary beams. The modulating frequency is unrestricted by the laser cavity bandwidth or the atomic linewidth. A He-Ne laser at 6328A and a beam mc/sec phonon in a quartz bar were used.

2525

Stanford U. Dept. of Mathematics, Calif.

ESTIMATES FOR THE TRANSFINITE DIAMETER OF A CONTINUUM, by E. Reich and M. Schiffer. [1964] [16]p. (AFOSR-65-1399) (AF 49(638)1345) AD 621352   Unclassified

Also published in Math. Zeitschr., v. 85: 91-106, 1964.

Some estimates for the transfinite diameter of a continuum are derived in terms of elementary geometric quantities connected with it. The main intention is methodological. Variational methods are applied, and the corresponding extremum continua are described by a functional differential equation. In all cases the determination of the extremum continuum is based on rather simple geometric arguments. It is intended that the arguments used should indicate more general methods of solution which could be applied in the calculus of variations for conformal mappings.

2526

Stanford U. Dept. of Mechanical Engineering, Calif.

A LITERATURE REVIEW ON SUBSONIC FREE TURBULENT SHEAR FLOW, by R. M. Halleen. Apr. 1964, 102p. incl. diagrs. tables, refs. (Rept. no. MD-11) (AFOSR-5444) (AF 49(638)1278) AD 606758   Unclassified

Solutions, for both two-dimensional flow and three-dimensional axially symmetric flow, are reviewed for the three major free turbulent shear flow topics: the turbulent shear layer, the turbulent wake, and the turbulent jet. Several models for the turbulent shear stress were used in some of these solutions. The solutions are compiled in consistent nomenclature and compared. For each of the three topics, the defining partial differential equations for the particular turbulent shear stress models and geometric conditions are given, followed by the transformation of the variables utilized in obtaining a solvable differential equation. Finally, the solution is presented. Experimental mean velocity profile data for each condition are correlated and reduced to a single curve using the least squares curve fitting technique. A table of coordinates for each curve is given, including the standard deviation from the mean. Other experimental information is also tabulated.

2527

Stanford U. Dept. of Mechanical Engineering, Calif.

ON THE SIGNS OF ONSAGER'S RECIPROCITY RELATIONS IN IRREVERSIBLE THERMODYNAMICS, by D. H. Gage and S. J. Kline. Mar. 1964, 11p. (Rept. no. IT-1) (AFOSR-64-1880) (AF 49(638)1278) AD 607377   Unclassified

The conventional presentation of Onsager's reciprocity relations specifies that the appropriate "flows and forces" used in the rate equations for irreversible, coupled processes are obtained from an arbitrary factorization of the entropy production expression. Closer examination shows that arbitrary selection of "flows", or dependent quantities, in the rate equations leads to an ambiguity of sign in Onsager's relations. For a system with n independent, coupled, irreversible processes, a proof is given that only two of the possible 2^n sets of rate equations obtained by arbitrarily factoring the entropy production expression completely obey $L_{ij} = L_{ji}$. The remaining $2^n - 2$ possible sets of rate equations will have at least one pair of coefficients which will obey the antisymmetric relation $L_{ij} = L_{ji}$. (Contractor's abstract)

2528

Stanford U. Dept. of Mechanical Engineering, Calif.

AN EXPERIMENTAL INVESTIGATION OF THE FLOW STRUCTURE OF THE TURBULENT BOUNDARY LAYER, by P. W. Runstadler, S. J. Kline, and W. C. Reynolds. June 1963, 308p. incl. illus. diagrs. tables, refs. (Rept. no. MD-8) (AFOSR-5241) (AF AFOSR-63-136) AD 421683   Unclassified

A combination of visual and quantitative measurements is presented, providing a physical picture of the turbulent boundary layer flow structure on a flat plate. The flow structure is shown to consist of three zones; each zone has a one to one correspondence to the well known regions of the u^+, y^+ mean velocity profile. A wall layer region is shown to exist below $y^+ = 10$. An entirely new result of the investigation is the delineation of the structure of the wall layer region. This region is shown to contain a relatively regular structure of low and high velocity fluid streaks alternating in the span direction, together with the ejection of low momentum fluid into the outer flow.

2529

Stanford U. [Dept. of Physics] Calif.

CONSEQUENCES OF A WEAK VECTOR BOSON FOR THE DECAY K MESON TO MUON PLUS NUTRINO PLUS PHOTON, by E. S. Ginsberg and R. H. Pratt. [1963] [3]p. (AFOSR-J852) (AF 49(638)388) AD 416464 Unclassified

Also published in Phys. Rev., v. 130: 2105-2109, June 1, 1963.

Consequences of an intermediate vector boson, with arbitrary anomalous magnetic and quadrupole moments, have been investigated for the decay K meson to muon plus nutrino plus photon. The results of a numerical calculation indicate that such a boson will have observable effects if its mass is not too great. Emission of photons at large backward angles with respect to energetic muons is significantly enhanced. Emission of high-energy photons at small forward angles is suppressed. The dependence of these effects on the mass and magnetic moment of the boson is discussed. Photon polarization phenomena are noted.

2530

Stanford U. Dept. of Physics, Calif.

COULOMB GREEN'S FUNCTION IN CLOSED FORM, by L. Hostler and R. H. Pratt. [1963] [2]p. (AFOSR-J967) (AF 49(638)388) AD 417146 Unclassified

Also published in Phys. Rev. Ltrs., v. 10: 469-470, June 1, 1963.

An expression in closed form for the nonrelativistic Coulomb Green's function has been obtained. Knowing the form of this expression, there is a simple derivation of the Green's function and some further results are summarized.

2531

Stanford U. [Dept. of Physics] Calif.

INELASTIC ELECTRON SCATTERING FROM NUCLEI AND SINGLE-PARTICLE EXCITATIONS, by W. Czyz. [1963] [8]p. (AFOSR-J1241) (AF 49(638)388) AD 424324 Unclassified

Also published in Phys. Rev., v. 131: 2141-2148, Sept. 1, 1963.

Arguments are presented that the single-particle excitations in nuclei induced by inelastically scattered electrons dominate the inelastic cross section in large domains of the momentum transfer (q) and the energy loss (ω). The sum rules for fixed q and ω are derived which include the transverse electron-nucleus interactions to order q^2/M^2 (M being the nucleon mass). The results of the calculations of the inelastic cross section for Cl_2 at θ 135° are discussed and compared with experimental data.

2532

Stanford U. [Dept. of Physics] Calif.

BARYON-BARYON INTERACTIONS AND THE EIGHT-FOLD WAY, by R. J. Oakes. [1963] [3]p. (AFOSR-J1435) (AF 49(638)388) AD 427708 Unclassified

Also published in Phys. Rev., v. 131: 2239-2241, Sept. 1, 1963.

The deuteron is shown to belong to a ten-dimensional irreducible representation of the group SU(3) in the symmetry scheme called the eightfold way. The baryon-baryon states, which together with the deuteron comprise this supermultiplet, are studied. Data are discussed which favor the existence of some of these states, and the masses of the remaining states are estimated.

2533

Stanford U. Dept. of Physics, Calif.

SU(4) MASS FORMULA, by R. J. Oakes and D. Speiser. [1964] [3]p. (AFOSR-64-2549) (AF 49(638)1389) AD 453884 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 579-581, Nov. 1964.

The mass formula is given for an arbitrary representation of SU(4) based on the assumption that the mass splittings transform like a component of the 15. This general result is greatly simplified by using different SU(3) subgroups of SU(4). To emphasize the general usefulness of the various subgroups, the electromagnetic properties in SU(4) are briefly discussed also.

2534

Stanford U. Dept. of Physics, Calif.

TABLES OF CLEBSCH-GORDAN COEFFICIENTS, OF SU_3, by P. McNamee and F. Chilton. [1964] [20]p. incl. tables. (AFOSR-65-0130) (AF 49(638)1389) AD 455707 Unclassified

Also published in Rev. Mod. Phys., v. 36: 1005-1024, Oct. 1964.

The Clebsch-Gordan coefficients are listed for the

decomposition of $|N, Y, I, L_3\rangle$ into
$|n, y, i, i_3\rangle \otimes |n', y', i', i_3'\rangle$. N ranges from 1 to 64.

2535

Stanford U. [Dept. of Physics] Calif.

BOUNDS ON PROPAGATORS, COUPLING CONSTANTS, AND VERTEX FUNCTIONS, by S. D. Drell, A. C. Finn, and A. C. Hearn. [1964] [13]p. incl. diagrs. refs. (AFOSR-65-0466) (AF 49(638)1389) AD 616183
Unclassified

Also published in Phys. Rev., v. 136: B1439-B1451, Dec. 7, 1964.

Several bounds on renormalization constants and on the asymptotic behavior of propagation functions and vertices are constructed. The inputs are experimental measurements and/or analyticity properties of vertex functions. The connection between zeros in propagators, poles in vertex functions, and the values of coupling constants are discussed. The possible physical significance of such zeros are considered in terms of an extended Lee model. In particular it is argued that there is no reason to exclude the existence of zeros in the propagator on the basis of this model and the scattering amplitude derived from it. This negates the arguments given for bounding the coupling constants in field theory.

2536

Stanford U. Dept. of Physics, Calif.

NUCLEON-NUCLEON SCATTERING WITH INELASTIC UNITARITY, by P. W. Coulter, A. Scotti, and G. L. Shaw. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0467) (AF 49(638)1389) AD 613841
Unclassified

Also published in Phys. Rev., v. 136: B1399-B1404, Dec. 7, 1964.

The effects of inelastic unitarity on dynamical calculation of nucleon-nucleon scattering are studied, using the N/D formalism for partial-wave amplitudes modified to take into account reaction channels by means of the inelastic factor n. The equations are solved for the D_2 amplitude for which the inelastic scattering is known, for laboratory kinetic energies $E_L \lesssim 800$ mev. Left-hand-cut Born terms determined by Scotti and Wong are used. The calculated phase shift δ agrees very closely with the Scotti-Wong results for $E_L \lesssim 200$ but deviates appreciably at higher energy, peaking at $\approx 400-500$ mev and going negative at $\gtrsim 1$ bev.

2537

Stanford U. Dept. of Physics, Calif.

$\mu^- + He^3 \rightarrow H^3 + \nu$ CAPTURE RATE, by R. J. Oakes. [1964] [3]p. incl. refs. (AFOSR-65-0844) (AF 49-(638)1389) AD 617041   Unclassified

Also published in Phys. Rev., v. 136: B1848-B1850, Dec. 21, 1964.

The muon capture rate in He^3 for the process $\mu^- + He^3 \rightarrow H^3 + \nu$ has been computed using nuclear wave functions suggested by recent analyses of $e - He^3$ and $e - H^3$ scattering experiments. The observed values are $(1.41 \pm 0.14) \times 10^3$ sec^{-1}, $(1.52 \pm 0.05) \times 10^3$ sec^{-1}, and $(1.44 \pm 0.09) \times 10^3$ sec^{-1}. It is concluded that the values are in good agreement with those of the Irving wave function, while the Irving-Gunn wave function leads to a rather small capture rate.

2538

Stanford U. Dept. of Physics, Calif.

POSSIBLE TEST OF THE BOOTSTRAP HYPOTHESIS, by A. W. Martin. [1964] [4]p. incl. refs. (AFOSR-65-1066) (AF 49(638)1389) AD 619751   Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1809-1812, Dec. 16, 1964.

The purpose of this note is to demonstrate that the spin-parity quantum numbers of 1405 mev Y_0^* provide a test of the reciprocal bootstrap hypothesis. It is pointed out that $p_{1/2}$ is a better spin-parity assignment for Y_0^* than is $s_{1/2}$, but if so, then the reciprocal bootstrap hypothesis must be either abandoned or substantially modified. A $p_{3/2}$ resonance is also considered, and an approach to the problem is suggested through the study of the strong decay $Y_1^* (1660) \rightarrow \Sigma + \pi + \pi$. Consideration is also given to the proposition that the reciprocal bootstrap hypothesis can work in Schwinger's W_3 model.

2539

Stanford U. [Dept. of Physics] Calif.

NEW CALCULATIONS OF THE ATOMIC PHOTO-EFFECT, by R. H. Pratt. [1963] 15p. (Rept. no. ITP-104) (AFOSR-J1256) (AF AFOSR-62-452) AD 424291   Unclassified

Presented at Internat'l. Conf. on the Role of Atomic Electrons in Nuclear Transformations, Warsaw (Poland), Sept. 1963.

Accurate predictions of cross section for the photoeffect can at present only be obtained with numerical methods. Such calculations for the K shell were made by Hulme et al for 3 elements and 2 energies and more recently by Hultberg, Nagel, and Olsson (HNO) for a series of energies in 2 heavy elements. Results are presented which have extended these calculations to encompass the range of elements from $Z = 13$ to $Z = 92$ and of energies from 200 kev to 2 mev, obtaining differential and total cross sections and all polarization correlations between incoming photon and ejected electron.

2540

Stanford U. [Dept. of Physics] Calif.

THE UNCOUPLED PHASE METHOD FOR INTERAC-
TIONS WITH HARD CORES, by P. Nath, G. L. Shaw,
and C. K. Iddings. [1964] [5]p. (AFOSR-64-0790)
(AF AFOSR-62-452) AD 436483   Unclassif ed

Also published in Phys. Rev., v. 133: B1085-B1089,
Feb. 24, 1964.

A system of n strongly coupled, two-body channels may
be sufficient to describe a given set of reactions. A
theoretical calculation on the other hand, might com-
pletely neglect one of these channels. The uncoupled
phase method (developed by Ross and Shaw) is a non-
pertubative formalism (based on a potential model) re-
lating the uncoupled scattering amplitudes describing
the n-1 channels to the actual amplitudes for all n
channels. It is demonstrated in this paper that the un-
coupled phase method remains a quantitative procedure
over a wider range of conditions than originally antici-
pated. The method is derived for interactions with hard
cores.

2541

Stanford U. [Dept. of Physics] Calif.

RADIATIVE CORRECTIONS TO HIGH-ENERGY INELAS-
TIC ELECTRON SCATTERING, by N. T. Meisler and
T. A. Griffy. [1964] [5]p. (AFOSR-64-0791)
(AF AFOSR-32-452) AD 436482   Unclassified

Also published in Phys. Rev., v. 133: B1032-B1036,
Feb. 24, 1964.

A method for calculating radiative corrections to high-
energy inelastic electron is detected at a given angle
and energy. As an example of this procedure, the
radiative corrections to inelastic electron-deuteron
scattering have been calculated.

2542

Stanford U. Dept. of Physics, Calif.

THEORY OF THE ELECTROMAGNETIC FORM
FACTORS OF H^3 AND He^3, by L. I. Schiff. [1964]
[11]p. incl. diagrs. (AFOSR-64-0792) (AF AFOSR-
62-452) AD 436481   Unclassified

Also published in Phys. Rev., v. 133: B802-B812,
Feb. 10, 1964.

A theoretical background is provided for recent experi-
ments on the elastic scattering of high-energy electrons
from H^3 and He^3. Formulas are derived on the basis
of the isotopic spin formalism that relate the observed
electric charge and magnetic moment form factors for
the two nuclei to the charge and moment form factors
of the proton and neutron, two form factors that de-
scribe the spatial distributions of the centers of the
like pair of nucleons and the odd nucleon (body form
factors), and an exchange magnetic movement form

factor that is to be determined empirically. The body
form factors are then calculated analytically for three
assumptions as to the dependence of the wave function
on the internucleon distance.

2543

Stanford U. [Dept. of Physics] Calif.

HIGH-FREQUENCY REGION OF THE SPECTRUM OF
ELECTRON AND POSITRON BREMSSTRAHLUNG. II,
by R. J. Jabbur and R. H. Pratt. [1964] [2]p. (AFOSR-
64-0793) (AF AFOSR-62-452) AD 436480
                                         Unclassified

Also published in Phys. Rev., v. 133: B1090-B1091,
Feb. 24, 1964.

The high-frequency limit of the bremsstrahlung spec-
trum from very high energy electrons has been calculated
exactly with numerical methods. It is found that, even
in the heaviest elements, only the s- and p-state partial
waves of the outgoing zero-energy electron contribute
significantly to the cross section: For Th(Z = 90) the s
state gives 56% of the total and the p state 42%, while
the d-state contribution is 2% and the f-state contribu-
tion 0.1%. It is also found that the s- and p-state cross
sections are well represented by analytic expressions
which we have given previously.

2544

Stanford U. Dept. of Physics, Calif.

ELECTROMAGNETIC STRUCTURE OF THE GIANT
DIPOLE RESONANCE, by F. H. Lewis, Jr. and J. D.
Walecka. [1964] [20]p. incl. diagrs. table, refs.
(AFOSR-64-1052) (AF AFOSR-62-452) AD 441494
                                         Unclassified

Also published in Phys. Rev., v. 133: B849-B868,
Feb. 1964.

The inelastic transverse form factor for electromag-
netic excitation of the giant resonance is discussed and
calculated on the basis of several different models.
Particular attention is paid to the Brown theory of the
giant resonance, which is reformulated here in such a
way that no free parameters are left over, i.e., all
parameters are determined from other experiments.
Numerical calculations are carried out for C^{12} and
compared with the 180° electron scattering experiments
and with photoabsorption data.

2545

Stanford U [Dept. of Physics] Calif.

OBSER)NAL BASIS OF MACH'S PRINCIPLE, by
L. I. Sch. [1964] [2]p.   (AFOSR-64-1149)
(AF AFOSR-62-452) AD 442816   Unclassified

Also published in Rev. Modern Phys., v. 36: 510-511,
Apr. 1964.

It appears at present that the observational basis for Mach's principle rests on a comparison between the rotation rates of the inner-planet inertial system and the fixed-stars coordinate system, and that the two systems agree within an uncertainty of about 0.4 sec/century.

2546

Stanford U. [Dept. of Physics] Calif.

APPROXIMATE SOLUTION TO THE N/D EQUATIONS, by G. L. Shaw. [1964] [4]p. (AFOSR-64-1153) (AF AFOSR-62-452) AD 442784   Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 345-348, Mar. 23, 1964.

The purpose of this note is to present an approximate solution to the N/D equations which has the exact same degree of simplicity as the determinantal method but (a) does not have certain drawbacks, and (b) for a number of interesting cases is a closer approximation to the actual solution.

2547

Stanford U. [Dept. of Physics] Calif.

ELECTRO-PRODUCTION OF PIONS FROM NUCLEI, by W. Czyz and J. D. Walecka. [1964] [9]p. (AFOSR-64-1154) (AF AFOSR-62-452) AD 442830
                                              Unclassified

Also published in Nuclear Phys., v. 51: 312-320, 1964.

The contribution of pion production to inelastic electron scattering from nuclei through a given angle and with a given energy loss has been calculated. The amplitude for the production from a single nucleon is taken from the work of Fubini, Nambu and Wataghin. A fermi gas model of the nuclear excitation spectrum is used in order to carry out the sum over final nuclear states. Both incoherent and coherent production are included. The cross sections are computed for energy losses above meson threshold and below the (3,3) resonance. Since the results are strongly dependent on the model of the excitation spectrum such experiments can give valuable information about nuclei.

2548

Stanford U. [Dept. of Physics] Calif.

THE VECTOR THEORY OF STRONG INTERACTIONS AND ANTI-NUCLEON-NUCLEON ANNIHILATION, by S. M. Berman and R. J. Oakes. [1963] [9]p. (AFOSR-64-1748) (AF AFOSR-62-452) AD 449264
                                              Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 1329-1337, Sept. 16, 1963.

The hypothesis that antinucleon-nucleon annihilation

at rest is dominated by single-particle intermediate states consisting of vector mesons is examined. The hypothesis is consistent with current experiments and offers an explanation of certain observed features of the annihilation process. Several critical tests are suggested to verify or repudiate the hypothesis.

2549

Stanford U. [Dept. of Physics] Calif.

ELECTROMAGNETIC STRUCTURE OF THE GIANT RESONANCE IN OXYGEN-16, by F. H. Lewis, Jr. [1964] [8]p. (AFOSR-64-1749) (AF AFOSR-62-452) AD 449265   Unclassified

Also published in Phys. Rev., v. 134: B331-B338, Apr. 27, 1964.

The transverse inelastic form factor for excitation of the giant resonance in oxygen-16 is calculated by means of the particle-hole theory of the giant resonance. The calculation is done in such a way that no free parameters are involved. In addition, calculations similar to those of Brown, Castillejo, and Evans have been carried out and the form factor has also been calculated for the Goldhaber-Teller model. The results are compared with 180° electron-scattering experiments and with photoabsorption data. It is found that the particle-hole calculations predict the observed behavior for the squared form factor, and also the change in the shape of the giant resonance cross section which is seen experimentally as the momentum transfer q is varied. Neither of these effects is predicted by the Goldhaber-Teller model.

2550

Stanford U. [Dept. of Physics] Calif.

K-SHELL PHOTOELECTRIC CROSS SECTIONS FROM 200 KEV TO 2 MEV, by R. H. Pratt, R. D. Levee and others. [1964] [18]p. (AFOSR-64-1751) (AF AFOSR-62-452) AD 449262   Unclassified

Also published in Phys. Rev., v. 134: A898-A915, May 18, 1964.

A numerical program has been developed for the calculation of atomic photoelectric differential and total cross sections, including all polarization correlations. The program is designed to calculate relativistic Coulomb wave functions in a screened central potential; the outgoing continuum wave function is obtained in a partial-wave series. Results are presented here for K-shell differential and total cross sections in point Coulomb potentials (i.e., unscreened) ranging from charge Z - 13 to Z = 92, and covering the range of incident photon energies from 200 kev to 2 mev.

2551

Stanford U. [Dept. of Physics] Calif.

NUCLEAR SIZE AND MAGNETIC EFFECTS IN THE

> 509 <

RADIATIVE TAIL OF ELECTRON-NUCLEUS
SCATTERING, by E. S. Ginsberg and R. H. Pratt.
[1964] [6]p. (AFOSR-64-1752) (AF AFOSR-62-452)
AD 449261   Unclassified

Also published in Phys. Rev., v. 134: B773-B778,
May 25, 1964.

The spectrum of scattered electrons due to bremsstrah-
lung from static nuclear charge and magnetic-moment
distributions is calculated in Born approximation. As
expected, large reductions from point-nucleus cross
sections are obtained for scattering involving large
momentum transfers and magnetic bremsstrahlung is
important in the same large-angle region where mag-
netic elastic scattering is appreciable. Integrations
were carried out numerically on an IBM-7090 computer
for some representative cases using form factors from
elastic electron scattering.

2552

Stanford U. [Dept. of Physics] Calif.

COULOMB GREEN'S FUNCTIONS AND THE FURRY
APPROXIMATION, by L. Hostler. [1965] [21]p.
(AFOSR-64-1763) (AF AFOSR-62-452) AD 449052
                                            Unclassified

Also published in Jour. Math. Phys., v. 5: 591-611,
May 1964.

The Coulomb Green's function for the nonrelativistic
Schrodinger equation is obtained in closed form starting
from the partial-wave expansion and using an integral
representation for a product of two Whittaker functions
with different arguments. The Neumann's series for
$Jv(kz)$ is required in evaluating the sum on states.
Using the same methods, the Coulomb Green's functions
for the Klein-Gordon and iterated Dirac equations are
obtained in closed form in the "Furry approximation".
The Klein-Gordon Green's function is shown to be at
the same time the exact Green's function for the Klein-
Gordon equation without the potential squared term.

2553

Stanford U. [Dept. of Physics] Calif.

POLARIZATION CORRELATIONS IN ATOMIC
PHOTOEFFECT, by R. H. Pratt, R. D. Levee and
others. [1964] [7]p. (AFOSR-64-1925) (AF AFOSR-
62-452) AD 450327   Unclassified

Also published in Phys. Rev., v. 134: A916-A922,
May 18, 1964.

The seven possible polarization correlations between
incident photon and ejected electron in K-shell photo-
effect have been obtained ith numerical methods for
the range of elements from Z = 13 to Z = 92 and the
range of energies from 200 kev to 2 mev. The photo-
effect can serve as a polarizer of electrons, a trans-
mitter of polarization from photons to electrons, or an
analyzer of polarized radiation. In heavy elements at

suitable angles of emission all these correlations can
be large. Previous work on the correlations is dis-
cussed.

2554

Stanford U. Dept. of Physics, Calif.

ELECTRODYNAMIC PROCESSES WITH NUCLEAR
TARGETS, by S. D. Drell and J. D. Walecka. [1964]
[16]p. incl. diagrs. (AFOSR-64-1926) (AF AFOSR-62-
452) AD 450328   Unclassified

Also published in Ann. Phys., v. 28: 18-33, June 1964.

It is known that two general form factors depending on
energy loss and momentum transfer characterize inelas-
tic electron scattering from nuclei in the first Born
approximation in $\sigma = 1/137$. The same two form factors
appear in all electrodynamic processes connected by
one photon exchange with nuclei. This observation is
used to compute cross sections and to discuss experi-
ments which are aimed at probing electrodynamics by
scattering or pair producing electrons or muons from
nuclear targets. (Contractor's abstract)

2555

Stanford U. Dept. of Physics, Calif.

UNIVERSAL THEORY OF SEMI-WEAK INTERACTIONS,
by R. E. Marshak, C. Ryan and others. [1964] [25]p.
incl. tables, refs. (AFOSR-64-1927) (AF AFOSR-
62-452) AD 450329   Unclassified

Also published in Nuovo Cimento, v. 32: 408-432,
Apr. 16, 1964.

A universal theory of semi-weak interactions is pro-
posed on the basis of a new baryon-lepton symmetry
principle and the conservation of a new quantum number
X, the weak hypercharge. The universality of the theory
is achieved by coupling two intermediate charged vector
bosons of different mass and X assignment to the strange-
ness-conserving and strangeness-changing currents.
Acceptance of the conserved vector current hypothesis
for strangeness-conserving processes leads to definite
statements concerning the fields describing the electron
and muon neutrinos, the $(\Delta Q/\Delta S)$ properties of the
strangeness-changing current and the existence of
neutrino flip.

2556

Stanford U. Dept. of Physics, Calif.

FORM FACTORS FOR STRONG M1 TRANSITIONS
IN LIGHT NUCLEI, by J. Goldemberg, W. C. Barber
and others. [1964] [3]p. incl. diagrs. table, refs.
(AFOSR-64-1987) (AF AFOSR-62-452 and Nonr-22567)
AD 453521   Unclassified

Also published in Phys. Rev., v. 134: B1022-B1024, June 8, 1964.

For abstract see item no. 2599.

2557

Stanford U. Dept. of Physics, Calif.

ELECTRIC DIPOLE MOMENT OF A NUCLEON, by N. T. Meister and T. K. Radha. [1964] [4]p. incl. diagrs. (AFOSR-64-2056) (AF AFOSR-62-452) AD 452381   Unclassified

Also published in Phys. Rev., v. 135: B769-B772, Aug. 10, 1964.

A violation of time-reversal invariance of any of the elementary particle interactions would imply the existence of a static electric-dipole moment for all these particles. A theoretical estimate is made of the electric-dipole moment of a bare nucleon, assuming the existence of an intermediate vector boson (W) and a small violation of T invariance for the weak interactions.

2558

Stanford U. Dept. of Physics, Calif.

CONSEQUENCES OF A WEAK VECTOR BOSON FOR THE DECAY $K \rightarrow \mu + \nu + e^+ + e^-$, by E. S. Ginsberg. [1964] [4]p. incl. diagrs. tables. (AFOSR-64-2057) (AF AFOSR-62-452) AD 452467   Unclassified

Also published in Phys. Rev., v. 135: B792-B795, Aug. 10, 1964.

The effect of an intermediate vector boson with arbitrary anomalous magnetic and quadrupole moments, has been investigated. The presence of the boson can have a striking effect on the orientation of the plane of the Dalitz pair relative to the decay plane. This effect is greatest in a kinematic region where the Dalitz pair emerges at a large backward angle with respect to energetic muons.

2559

Stanford U. Dept. of Physics, Calif.

SELF-CONSISTENT CALCULATION OF THE ρ-MESON REGGE POLE, by M. Bander and G. L. Shaw. [1964] [5]p. incl. diagrs. refs. (AFOSR-64-2058) (AF AFOSR-62-452) AD 452468   Unclassified

Also published in Phys. Rev., v. 135: B267-B271, July 13, 1964.

The left-hand discontinuities in the partial-wave amplitudes for R-R scattering are assumed to be dominated by the exchange of the rho meson in a form suggested by the Regge representation for a resonance.

2560

Stanford U. Dept. of Physics, Calif.

MESON EXCHANGE EFFECTS IN ELASTIC e-d SCATTERING, by R. J. Adler and S. D. Drell. [1964] [4]p. incl. diagrs. refs. (AFOSR-64-2338) (AF AFOSR-62-452) AD 451934   Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 349-352, Sept. 7, 1964.

This note reports a calculation of an effect of the three-pion-exchange current on the electromagnetic interaction of the deuteron.

2561

Stanford U. Dept. of Physics, Calif.

ELECTRON-PROTON COINCIDENCE CROSS SECTION FOR He^3 AND H^3, by T. A. Griffy and R. J. Oakes. [1964] [7]p. incl. diagrs. refs. (AFOSR-64-2339) (AF AFOSR-62-452) AD 451935   Unclassified

Also published in Phys. Rev., v. 135: B1161-B1167, Sept. 7, 1964.

This cross-section is evaluated for the Gaussian, Irving, and Irving-Gunn three-body wave functions, the deuteron being described by a Hulthen wave function. The best agreement with the preliminary experimental results is obtained using the Irving-Gunn wave function.

2562

Stanford U. Dept. of Physics, Calif.

UNITARITY AND FORM FACTORS IN THE PRODUCTION PROCESS $\pi + N \rightarrow \rho + N$, ny M. H. Ross. [1964] [4]p. incl. diagrs. refs. (AFOSR-64-2340) (AF AFOSR-62-452) AD 451928   Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 627-630, June 1, 1964.

The peripheral model has provided a relatively successful interpretation of many high-energy reactions. In this paper one of the most thoroughly examined reactions, $\pi + N \rightarrow \rho + N$, is considered in order to better understand the peripheral model and to elucidate the nature of the ρ resonance.

2563

Stanford U. Dept. of Physics, Calif.

ANGULAR CORRELATIONS IN PRODUCTION PROCESSES, by S. M. Berman and R. J. Oakes. [1964] [7]p. incl. tables. (AFOSR-64-2370) (AF AFOSR-62-452) AD 452419   Unclassified

Also published in Phys. Rev., v. 135: B1034-B1040, Aug. 24, 1964.

A simple and general method is suggested for studying processes in which resonances or unstable particles are produced. The method consists of analyzing the experimental data in terms of all the possible angular correlations among the decay products of the produced particles. The specific correlations that can be present in a number of experimentally feasible processes are explicitly tabulated. The usefulness of this method of analysis is illustrated by showing how the correlations provide extensive tests of various dynamical models of the production process such as one-particle exchanges. (Contractor's abstract, in part)

2564

Stanford U. [Dept. of Physics] Calif.

RADIATIVE CORRECTIONS TO ELECTRON SCATTERING, by Y.-S. Tsai. [1964] [7]p. incl. diagrs. (AFOSR-64-2373) (AF AFOSR-62-452) AD 452263
Unclassified

Also published in Proc. Internat'l. Conf. on Nucleon Structure, Stanford, Calif. (June 24-27, 1963), ed. by Hofstadter and Schiff. Stanford U. Press, 1964, p. 221-227.

Radiative corrections for an arbitrary one-photon exchange process are calculated, assuming that the target particle is not polarized and that the final products of the target particle are not detected experimentally.

2565

Stanford U. Dept. of Physics, Calif.

THEORY OF PROTON COMPTON SCATTERING, by A. C. Hearn and E. Leader. [1964] [2]p. incl. diagr. (AFOSR-64-2374) (AF AFOSR-62-452) AD 452261
Unclassified

Also published in Proc. Internat'l. Conf. on Nucleon Structure, Stanford, Calif. (June 24-27, 1963), ed. by Hofstadier and Schiff. Stanford U. Press, 1964, p. 314-315.

Preliminary results are reported of a quantitative calculation of the differential cross section for proton Compton scattering using a fixed-angle dispersion-relation formalism that has been reported previously (A. C. Hearn and E. Leader, Phys. Rev., v. 126: 789, 1962).

2566

Stanford U. Dept. of Physics, Calif.

DEPOLARIZATION OF SPIN-1/2 PARTICLES BY ELECTROMAGNETIC SCATTERING, by C. K. Iddings and G. L. Shaw. [1964] [10]p. incl. tables, refs. (AFOSR-64-2512) (AF AFOSR-62-452) AD 453799
Unclassified

Also published in Phys. Rev., v. 135: B1388-B1397, Sept. 21, 1964.

A study is made of the depolarization of polarized, relativistic fermions (spin 1/2) passing through matter. The final polarization of the projectile shows two features, (1) a rotation of the polarization vector so that it does not have the same direction as the initial polarization with respect to the initial or final momenta: rotation; and (2) an unpolarized component so that the magnitude of the polarization has diminished: shrinkage.

2567

Stanford U. Dept. of Physics, Calif.

THERMAL NEUTRON CAPTURE BY DEUTERIUM AND STRUCTURE OF THE THREE-BODY WAVE FUNCTION, by T. K. Radha and N. T. Meister. [1964] [8]p. incl. tables, refs. (AFOSR-65-0136) (AF AFOSR-62-452) AD 455980
Unclassified

Also published in Phys. Rev., v. 136: B388-B395, Oct. 26, 1964.

The study of three-nucleon wave functions has recently drawn considerable attention owing to experiments on elastic scattering of high-energy from H^3 and He^3. An attempt is made to obtain independent information on these wave functions using the available experimental data on slow-neutron capture by deuterium. This reaction goes mainly through magnetic dipole radiation from both exchange and spin magnetic-moment interaction. Three types of three-body wave functions, Gaussian, Irving, and Irving-Gunn are considered. An upper limit on the probability of the S' state of mixed symmetry ($^2S_{1/2}$ state with $T = \frac{1}{2}$) is deduced from the experimental capture rate.

2568

Stanford U. Dept. of Physics, Calif.

ON THE RADIATIVE CORRECTIONS TO THE MUON POLARIZATION FROM PION DECAY, by E. S. Ginsberg and R. H. Pratt. [1964] [5]p. incl. diagr. (AFOSR-65-1356) (AF AFOSR-62-452) AD 621349
Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1633-1637, Dec. 16, 1964.

The polarization of muons from pion decay, $\pi \to \mu + \nu$, or electrons from kaon decay, $K \to e + \nu$, is not complete when radiative corrections are taken into account. The transition rates for radiative kaon and pion decay are used to find the lowest-order radiative correction to the polarization of the emitted muons or electrons. It is concluded that the correction is very small for all such decays.

2569

Stanford U. Dept. of Physics, Calif.

INSIDE QUANTUM FIELD THEORY AND LECTURES
ON NEUTRINO INTERACTIONS, by F. Chilton. Dec.
1964, 34p. incl. diagrs. (ANL rept. no. 6989)
(AFOSR-65-1753) (In cooperation with Argonne National
Lab., Ill.) (AF AFOSR-62-452) AD 623189
Unclassified

The fundamental ideas of quantum theory are reviewed
and summarized with special emphasis on those features
that are relevant to applications and omitting the for-
malism of second quantization. A formalism is first
developed for noninteracting fields. It is shown how
inclusion of interacting fields in the formalism can be
accomplished by use of the Lagrangian. Rules for
calculations are listed and explained, and examples are
given. Neutrino interactions are discussed and special
consideration is given to hyperon production by neutrinos
in an SU_3 model. .

2570

Stanford U. [Dept. of Physics] Calif.

CROSS SECTION FOR HYPERON PRODUCTION BY
NEUTRINOS, by F. Chilton. Aug. 1963, 14p. (Rept.
no. ITP-95) (AF AFOSR-62-452) AD 435577
Unclassified

The cross section, differential in q square, is calculated
for hyperon production by neutrinos (or any other spin
1/2 to spin 1/2 reaction). All six form factors are
included. A closed form for the total cross section is
given in the form of an expansion about asymptotic
value assuming a q square dependence of the form fac-
tors.

2571

Stanford U. [Dept. of Statistics] Calif.

FINITE STATE TRANSFORMATIONS, by R. C.
Jeffrey. [1964] [10]p. (AFOSR-64-0947) (AF AFOSR-
62-385) AD 440056 Unclassified

Also published in Inform. and Control, v. 7: 45-54,
Mar. 1964.

A notion of index is defined for transformations which
map n-tuples of words into m-tuples of words into m-
tuples of words, and it is proved that the transforma-
tions of finite index are precisely those which are
effected by finite state sequential machines, provided
these are allowed to have certain unusual features.
Further conditions are formulated which, together with
the finite index requirement, characterize the trans-
formations which can be effected by finite state
sequential machines of the usual sort. (Contractor's
abstract)

2572

Stanford U. [Dept. of Statistics] Calif.

SOLUTIONS OF PARABOLIC BOUNDARY PROBLEMS
EXISTING FOR ALL TIME, by P. Fife. [1964] [32]p.
(AFOSR-64-2277) (AF AFOSR-63-346) AD 452394
Unclassified

Also published in Arch. Rational Mech. and Anal.,
v. 16: 155-186, 1964.

The primary goal of this paper is to answer two
questions concerning parabolic boundary problems
existing for all time in the case of second order linear
equations, and a question for certain second order quasi-
linear equations. A secondary purpose is to apply the
results to two important particular cases, the first being
when the operator and data are periodic in t (then the
solution is also); and the second being when the data and
coefficients of the operator approach limit functions of
x alone as t approaches infinity.

2573

Stanford U. [Dept. of Statistics] Calif.

PREFERENCE, CREDENCE, AND UTILITY, by R. C.
Jeffrey. [1964] [42]p. (AFOSR-64-2498) (AF AFOSR-
64-529) AD 609560 Unclassified

Also published in Studies in Inductive Logic and
Probability, ed. by R. Carnap, Chapter 1, 1964.

Topics covered in this report include: Bayesian delibera-
tion; Bayesian preference rankings; Preference preserv-
ing utility transformations; Gambles, quantization, and
boundedness, and Unicity.

2574

Stanford U. [Dept. of Statistics] Calif.

GENERALIZED LEAST SQUARES ESTIMATORS FOR
RANDOMIZED FRACTIONAL REPLICATION DESIGNS,
by S. Zacks. Mar. 15, 1963, 28p. incl. refs. (Tech-
nical rept. no. 86) (AFOSR 4677) (Nonr-22552)
AD 400398 Unclassified

Also published in Ann. Math. Stat., v. 35: 696-704,
1964.

Statistical properties of the generalized least squares
estimators, under randomized fractional replication
designs, are presented. The term generalized least-
squares estimators is used since the matrices of the
normal equations corresponding to these designs are
singular. The factorial models corresponding to the
type of fractional replication designs studied in the
present paper are also presented. The discussion starts
from the factorial model for a full factorial system.
The required algebra, and the method of constructing
the orthogonal fractional replications is presented. The
linear spaces associated with the various orthogonal
fractional replication designs are characterized in terms
of the linear coefficients of the corresponding factorial
models. Some statistical properties under procedures
of choosing a fractional replication at random are studied.

2575

Stanford U. [Dept. of Statistics] Calif.

THE ASYMPTOTIC NORMALITY OF TWO TEST
STATISTICS ASSOCIATED WITH THE TWO-SAMPLE
PROBLEM, by S. Blumenthal. Feb. 28, 1963, 31p.
incl. refs. (Technical rept. no. 85) (AFOSR-4678)
(Nonr-22552) AD 400399   Unclassified

Also published in Ann. Math. Stat., v. 34: 1513-
1523, 1963.

Proofs are presented for the asymptotic normality
of two statistics which have been proposed to test the
hypothesis that two samples come from the same parent
population. Limiting normality under a fairly wide
class of alternatives is proven. Comparison is made
of the limiting power of these tests. The method, a
study of conditional moments, can also be used to prove
limiting normality of combinatorial statistics of greater
generality than the sum of squares statistics which is
studied in detail.

2576

Stanford U. Dept. of Statistics, Calif.

CONVEX HULL OF A RANDOM SET OF POINTS, by
E. Bradley. Jan. 25, 1965, 26p. (Technical rept. no.
103) (AFOSR-65-0615) (Nonr-22552) Unclassified

Various expectations connected with the convex hull of
a random set of points are derived. The points are
chosen independently in the plane or in higher dimen-
sions, and formulas are given for the expected area,
perimeter, volume, number of vertices. The formulas
are particularly simple for an underlying normal dis-
tribution.

2577

Stanford U. Dept. of Statistics, Calif.

ADAPTIVE STATISTICAL PROCEDURES IN RELIA-
BILITY AND MAINTENANCE PROBLEMS, by J. H.
Venter and J. L. Gastwirth. Oct. 12, 1964, 30p. incl.
diagrs. refs. (Technical rept. no. 99) (AFOSR-65-
0633) (Nonr-22552) AD 608726   Unclassified

A system with a lifetime that has the distribution func-
tion $F(t)$ is inspected at times, t_1, t_2, ... The inspec-
tion plan, the sequence t_1, t_2, ..., is to be chosen
in an optimal way. The case considered is that in
which the system has an exponential lifetime. Several
adaptive or sequential inspection plans are proposed
to estimate the unknown parameter in $F(t)$ and thereby
approach the plan that would be optimum if the parame-
ter were known. The two types of plans proposed are
based on maximum likelihood methods and refinements
of the Robbins-Monro stochastic approximation method.

2578

Stanford U. Dept. of Statistics, Calif.

ON SAMPLED DATA FEEDBACK CONTROL, by Y.
Suzuki. Oct. 15, 1964 [51]p. incl. tables. (Technical
rept. no. 100) (AFOSR-65-0634) (Nonr-22552)
AD 608732   Unclassified

In a manufacturing process which continuously pro-
duces a certain product and has expressed as a function
the deviation from the desired characteristics, the
problem is to find the control procedure of the process
by which the best performance is attained. Special
types of random functions are considered as the output
of the manufacturing process without control, and these
characterize the manufacturing processes to be con-
trolled. Three types of control procedure, the pro-
portional control, the integral control, and a mixture of
both are discussed.

2579

Stanford U. Dept. of Statistics, Calif.

EFFECT OF GROUP SIZE ON GROUP PERFORMANCE,
by H. Solomon. Oct. 28, 1964 [24]p. incl. tables, refs.
(Technical rept. no. 101) (AFOSR-65-0635) (Nonr-
22552)   Unclassified

The efficiency of groups over individuals in various
problem-solving situations has been explored in recent
years. Lorge and Solomon have proposed a model for
group behavior in the solution of eureka type problems.
This model has been applied to data resulting from a
verbal recall experiment. A model for individual be-
havior in recall has been proposed by Miller and McGill,
and this has been used to establish a group behavior
model in verbal recall using the Lorge-Solomon model.
Data has been available by experimentation, and the
implications of the model are examined by use of the
data. The group sizes examined are from 2 through 8
individuals.

2580

Stanford U. Dept. of Statistics, Calif.

CALCULATION OF UPPER TAIL PERCENTILES
FOR THE CHI-SQUARE DISTRIBUTION, by H. Rubin
and J. V. Zidek. Dec. 1, 1964 [13]p. incl. tables.
(Technical rept. no. 102) (AFOSR-65-0636) (Nonr-
22552)   Unclassified

This report describes a procedure for determining
upper tail percentiles of the chi-square distribution
with an arbitrary number of degrees of freedom. It
consists of two main parts. The first is a description
of an effective iterative technique, which is to be pub-
lished by H. Rubin, for solving equations of the form
$f(x) = 0$, given the feasibility of computing f and its
derivatives. The second, in the application of this tech-
nique to the chi-square distribution, is the continued

fraction approximation to the tail integral of the chi-square density function. An alternative procedure is given for the cases in which the sequence of approximants to this continued fraction converge slowly.

2581

Stanford U. [Dept. of Statistics] Calif.

THE CONVERGENCE OF A RANDOM DISTRIBUTION FUNCTION ASSOCIATED WITH A BRANCHING PROCESS, by P. E. Ney. Mar. 12, 1964, 26p. (Technical rept. no. 96) (Nonr-22552) AD 434059
Unclassified

A general branching process is constructed from the standard one by associating with each particle a "type", namely a point in a space which is taken to be d-dimensional Euclidian space. At any given time, each particle existing at that time is to be considered as located at a point in the given space. The diffusion of the particles throughout the space is shielded. The branching character of the process alone implies detailed results about its asymptotic behavior, without requiring any specific distribution assumptions.

2582

Stanford U. [Dept. of Statistics] Calif.

COUNTER MODELS AND APPLICATIONS TO DETECTION PROBLEMS, by H. Zweig. Apr. 12, 1963, 73p. (Technical rept., no. 87) (Nonr-22552) AD 402352
Unclassified

The quantum efficiency is derived of a variety of detectors for which mathematical models already exist and to develop new models for some physical situations which can be examined in this light. A summary of the models which will be analyzed is given. The application of these models to specific detection problems is indicated. The methods of estimating the parameter of interest and the efficiency of the estimates is defined. A summary is presented of known dead time counter models and their quantum efficiency is evaluated. A new class of counters, called coincidence counters, is introduced and evaluated.

2583

Stanford U. [Dept. of Statistics] Calif.

AN OBSTACLE-COURSE PROBLEM: I, by J. Kadane. July 30, 1964, 17p. (Technical rept. no. 98) (Nonr-22552) AD 604439
Unclassified

An obstacle course is presented in which n obstacles are given, together with the probability of successfully overcoming the t(th) obstacle. A runner is permitted to choose r < or = n (r fixed) obstacles and to order them, so that he maximizes his expected value, on the assumption that once he fails to overcome an obstacle he receives only the points previously earned. The optimal ordering of the chosen r is a simple function of the obstacle parameters. The optimal choice

of which r to attempt is more complicated, and three alternative computational procedures are given, together with a proof that each will terminate at the optimal r, and an upper bound on the number of comparisons required for each.

2584

Stanford U. [Dept. of Statistics] Calif.

ON AGE DEPENDENT BRANCHING PROCESSES, by H. Weiner. Jan. 27, 1964, 79p. (Technical rept. no. 94) (Nonr-22552) AD 430995
Unclassified

This paper deals with asymptotic properties of various models of age-dependent branching processes. Cell growth is considered in which a cell proceeds in a sequential manner through n independent states, state R with its life distribution FR, $R = 1, 2, \ldots n$. At the end of mitosis, the nth state, the cell divides into similar cells, the number of which is governed by a generating function h, independent of the time and other cells of the process. A variation of the given model treats cell growth in which the cell proceeds from state to state according to a general semi-Markov process until the mitotic state is completed, when division into similar cells in accord with h occurs. Another case is that of two types of cells, of which only one type may divide while the other either accumulates or is eventually absorbed in the medium.

2585

Stanford U. [Dept. of Statistics] Calif.

PERCENTILE MODIFICATIONS OF TWO SIMPLE RANK TESTS, by J. L. Gastwirth. Feb. 11, 1964, 27p. (Technical rept. no. 95) (Nonr-22552) AD 433869
Unclassified

A simple method is presented for increasing the efficiency of rank tests relative to the best tests for samples from normal distributions without using complicated scoring systems such as the normal scores tests. Two numbers p and r (0 is less than p, r is less than 1) are selected and then scored, with simple weights, the data in the upper pth and lower rth percentiles of the combined sample. The optimum values of p and r depend on the populations sampled. For most distributions, the efficiency, is near its maximum in a large neighborhood of the optimum choice of p and r. The criterion used to compare tests is Pitman's efficiency.

2586

[Stanford U. Div. of Engineering Mechanics, Calif.]

OPTIMUM AND QUASI-OPTIMUM CONTROL OF THIRD- AND FOURTH-ORDER SYSTEMS, by I. Flügge-Lotz and H. A. Titus. [1963] [8]p. incl. diagrs. (AFOSR-66-0039) (AF 49(638)513) AD 640790
Unclassified

Also published in Automatic and Remote Control;
Proc. Second Cong. of the Internat'l. Fed.
Automatic Control, Basle (Switzerland), 1963, p. 363-
370.

Based on experiences with second-order plants, a sys-
tematic attempt has been made to approximate the
exact switching surfaces for third-order plants. There
is an approximation of the surface portion close to the
origin (the so-called "inner" surface) and an approxima-
tion of the larger portion of the switching surface which
is not close to the origin (the "outer" surface). Exam-
ples show the use of these surfaces; their results are
compared to results with exactly optimum switching.
They agree well. The extension to fourth-order systems
is indicated.

2587

Stanford U. [Div. of Engineering Mechanics] Calif.

FINITE-DIFFERENCE COMPUTATION OF THE
BOUNDARY LAYER WITH DISPLACEMENT THICK-
NESS INTERACTION, by F. G. Blottner and I.
Flügge-Lotz. [1963] [27]p. incl. diagrs. refs. (AFOSR-
64-1941) (AF 49(638)550) AD 450324   Unclassified

Also published in Jour. Mécanique, v. 2: 397-423,
Dec. 1963.

An implicit finite-difference method is used for solving
first-order boundary-layer problems under most gen-
eral conditions, given pressure distribution and given
wall temperature or heat transfer at the wall for real-
istic Prandtl number and viscosity law. When for
higher Mach numbers there is displacement thickness
interaction with external flow, the implicit finite-dif-
ference scheme is combined with an iteration procedure
to solve the boundary-layer equations. Flows along
an insulated and along a cold flat plate at Mach number
9.6 are solved with this numerical scheme. This
rather severe test case shows the wide applicability of
the method. (Contractor's abstract)

2588

Stanford U. Div. of Engineering Mechanics, Calif.

THE LAMINAR COMPRESSIBLE BOUNDARY LAYER
ALONG A WAVE-SHAPED WALL, by T. Fannelöp and
I. Flügge-Lotz. [1963] [12]p. incl. diagrs. (AFOSR-
64-0727) (AF AFOSR-62-242) AD 436024
Unclassified

Also published in Ingen. Arch., v. 33: 24-35, 1963.

As a result of inaccuracies inherent in an economical
manufacturing method, the exterior surfaces of air-
crafts and missiles may have a slightly wavy contour.
The waves have in most cases a very small amplitude
but if their wavefronts are in a direction transverse
to the external flow, the resulting pressure fluctuations
may nevertheless have considerable influence on the
behavior of the boundary layer. The same is true for
wind tunnels where in particular the diffusor-section
may be critical. The first investigation of the effect

of periodic pressure fluctuations on the behavior of the
incompressible laminar boundary layer was undertaken
by Quick and Schröder in 1944 using a numerical
method. The purpose of the present investigation is
to extend Quick and Schröder's investigation to compres-
sible flow with adiabatic as well as non-adiabatic wall
temperatures.

2589

Stanford U. [Div. of Engineering Mechanics] Calif.

THE LAMINAR COMPRESSIBLE BOUNDARY-LAYER
IN THE STAGNATION-POINT REGION OF AN AXISYM-
METRIC BLUNT BODY INCLUDING THE SECOND-
ORDER EFFECT OF VORTICITY INTERACTION, by
R. T. Davis and I. Flügge-Lotz. [1964] [30]p.
(AFOSR-64-1720) (AF AFOSR-62-242) AD 448279
Unclassified

Also published in Internat'l. Jour. Heat and Mass
Transfer, v. 7: 341-370, 1964.

The influence of external vorticity on the laminar com-
pressible boundary layer is examined in the stagnation-
point region of an axisymmetric blunt body. The case
considered is one where the vorticity is generated by a
curved bow-shock wave formed by the body moving at a
supersonic speed. The method of solution used is due
to Van Dyke and consists of solving first-order (or
Prandtl) boundary-layer equations and then solving
second-order equations for the vorticity effect, where
by second-order is meant second-order in a perturba-
tion parameter related to the inverse square root of a
Reynolds number.

2590

Stanford U. Div. of Engineering Mechanics, Calif.

COMPUTATION OF THE LAMINAR COMPRESSIBLE
BOUNDARY LAYER, by I. Flügge-Lotz. Final rept.
May 1963-June 1964 [155]p. incl. diagrs. tables, refs.
(AFOSR-64-1628) (AF AFOSR-63-235) AD 607573
Unclassified

First- and second-order boundary-layer theory are
examined in detail for some specific flow cases of prac-
tical interest. These cases are for flows over blunt
axisymmetric bodies in hypersonic high-altitude (or
low density) flow where second-order boundary-layer
quantities may become important. These cases consist
of flow over a hyperboloid and a paraboloid both with
free-stream Mach number infinity and flow over a sphere
at free-stream Mach number 10. The method employed
in finding the solutions is an implicit finite-difference
scheme. It is found to exhibit both stability and accu-
racy in the examples computed. The method consists
of starting near the stagnation-point of a blunt body and
marching downstream along the body surface.

2591

Stanford U. Div. of Engineering Mechanics, Calif.

SECOND-ORDER BOUNDARY-LAYER EFFECTS IN
HYPERSONIC FLOW PAST AXISYMMETRIC BLUNT
BODIES, by R. T. Davis and I. Flügge-Lotz. [1964]
[31]p. incl. diagrs. tables, refs. (AFOSR-65-0626)
(AF AFOSR-63-235) AD 614719   Unclassified

Also published in Jour. Fluid Mech., v. 20: 593-623,
1964.

First- and second-order boundary-layer theory are
examined in detail for some specific flow cases of
practical interest. These cases are for flows over
blunt axisymmetric bodies in hypersonic high-altitude
(or low density) flow where second-order boundary-
layer quantities may become important. These cases
consist of flow over a hyperboloid and a paraboloid
both with free-stream Mach number infinity and flow
over a sphere at free-stream Mach number 10. The
method employed in finding the solutions is an implicit
finite-difference scheme. It is found to exhibit both
stability and accuracy in the examples computed. The
method consists of starting near the stagnation-point
of a blunt body and marching downstream along the
body surface.

2592

Stanford U. [High-Energy Physics Lab.] Calif.

A STUDY OF TRANSISTOR BLOCKING OSCILLATORS
AS NANOSECOND-PULSE GENERATORS, by J. C.
MacDonald. Aug. 1963 [49]p. incl. diagrs. tables,
refs. (Technical rept. no. 4813-3; rept. no. SEL-63-
068) (AFOSR-5534) (Nonr-22567)   Unclassified

This study presents a method for calculating the
switching time and pulse duration of transistor blocking
oscillators operating in the nsec time domain. The
original theory proposed by Linvill and Mattson is
tested using transistors with increasing alpha cutoff
frequency. It is found that this theory gives close
correlation between measured and calculated switching
times for low-frequency transistors; however, for high-
frequency units, differences as large as an order of
magnitude exist. It is shown that for circuits with
switching times of less than 10 nsec, a new circuit
model is necessary; for good theoretical and measured
correlation. It is shown that a small-signal analysis,
as proposed by Linvill and Mattson, adequately de-
scribes the circuit operation. Design techniques for
minimizing switching time, based on the new circuit
models, are presented.

2593

Stanford U. High-Energy Physics Lab., Calif.

EXCITATION OF THE ELECTRIC DIPOLE GIANT
RESONANCE BY INELASTIC ELECTRON SCATTER-
ING AT 180°, by J. Goldemberg, Y. Torizuka and

others. [1963] [12]p. incl. diagrs. table, refs. (Rept.
no. HEPL-280) (AFOSR-J921) (Nonr-22567)
Unclassified

Also published in Nucl. Phys., v. 43: 242-253, 1963.

The cross section for the excitation of the nuclear giant
resonance by electrons is calculated in a model in
which the protons are assumed to oscillate as a unit
against the neutrons (Goldhaber-Teller model). The
longitudinal component of the field of the electrons is
shown to have a cross section that agrees with results
obtained previously by Fallieros, Ferrell and Pal. The
transverse component is shown to have a form factor
proportional to the elastic scattering form factor. Pre-
liminary measurements in C, Al and Kr with 41.5 mev
electrons scattered at 180°, where only the transverse
component is present, show cross sections smaller by
about a factor of four than the calculated ones.

2594

Stanford U. High-Energy Physics Lab., Calif.

ELECTROMAGNETIC STRUCTURE OF THE GIANT
DIPOLE RESONANCE, by F. H. Lewis, Jr., J. D.
Walecka and others. [1963] [3]p. incl. diagrs. (Rept.
no. HEPL-292) (AFOSR-J968) (Nonr-22567)
Unclassified

Also published in Phys. Rev. Ltrs., v. 10: 1-3,
June 1, 1963.

Inelastic electron scattering yields valuable information
about the spatial nature of the transition charge, cur-
rent, and magnetization densities in nuclei. Since the
electron part of the process is completely calculable,
one can directly compare the experimental inelastic
form factors (functions of the momentum transferred to
the nucleus) with the predictions of nuclear theory.
Different nuclear models can give quite different be-
havior for these form factors, and thus electron scat-
tering provides a unique tool for elucidating nuclear
structure. Some experimental and theoretical results
are presented on the nature of the giant dipole resonance
in C^{12} illustrating these points.

2595

Stanford U. [High-Energy Physics Lab.] Calif.

INELASTIC ELECTRON-DEUTERON SCATTERING
EXPERIMENTS AND NUCLEON STRUCTURE, by
C. de Vries, R. Hofstadter and others. [1964] [11]p.
incl. diagrs. tables, refs. (Rept. no. HEPL-321)
(AFOSR-64-1929) (Nonr-22567)   Unclassified

Also published in Phys. Rev., v. 134: B848-B859,
May 1964.

Inelastic electron-scattering experiments are reported
for four-momentum transfers from 3.0 to 22.0 F^{-2}.
The results of these measurements have been combined
with values of proton cross sections measured in the
same region of q^2 and have been analyzed in terms of
a three-pole Clementel-Villi model for the isotopic

form factors. Parameters appearing in this model have been adjusted by statistical methods. The minimum values of χ^2 obtained show that the different blocks of information on elastic electron-proton and inelastic electron-deuteron cross sections measured at Stanford are consistent with each other. An important result of the analysis is that the cross sections cannot be fitted with only one $T = 1$, $J = 1$ multipion resonance, unless the effective mass of such a particle is taken to be approximately 600 mev. (Contractor's abstract)

2596

Stanford U. High-Energy Physics Lab., Calif.

NONSATURATING QUANTAMETER FOR VERY HIGH INTENSITY GAMMA-RAY MONITORING, by H. Fischer and C. Schaerf. [1964] [3]p. incl. illus. diagrs. (Rept. no. HEPL-309) (AFOSR-64-1930) (Nonr-22567)   Unclassified

Also published in Rev. Scient. Instr., v. 35: 615-617, May 1964.

A new type of gamma-ray monitor is described which is capable of handling the very high intensities now available from linear electron accelerators. This device provides an output proportional to the incident power. Unfortunately, it is not an absolute monitor.

2597

Stanford U. High-Energy Physics Lab., Calif.

EXCITATION OF THE GIANT RESONANCE IN C^{12} AND O^{16} BY INELASTIC ELECTRON SCATTERING, by J. Goldemberg and W. C. Barber. [1964] [9]p. incl. diagrs. tables, refs. (Rept. no. HEPL-320) (AFOSR-64-1931) (Nonr-22567)   Unclassified

Also published in Phys. Rev., v. 134: B963-B971, June 8, 1964.

The excitation of the electric-dipole giant resonance in C^{12} and O^{16} was studied by measuring the spectrum of electrons inelastically scattered at 180°. Experiments were made with incident electrons of 40, 55, and 70 mev; combining these data with the known photon absorption cross section a form factor for the giant resonance cross section is obtained for momentum transfers up to 120 mev/c. The form factor for the combined strength of the main giant resonance in C^{12} and O^{16} which is concentrated between 20 and 25 mev has a very characteristic shape going through a shallow minimum and increasing again with the momentum transfer.

2598

Stanford U. High-Energy Physics Lab., Calif.

FORM FACTORS FOR STRONG M1 TRANSITIONS IN LIGHT NUCLEI, by J. Goldemberg, W. C. Barber

and others. [1964] [3]p. incl. diagrs. table, refs. (Rept. no. HEPL-317) (AFOSR-64-1932) (AF AFOSR-62-452 and Nonr-22567) AD 453521
                    Unclassified

Also published in Phys. Rev., v. 134: B1022-B1024, June 8, 1964.

Strong peaks corresponding to magnetic-dipole excitation of the nucleus were observed in the energy spectrum of electrons scattered at 180° from targets of Li^6C, Mg, and Si. The momentum transfer dependence of the excitation of these peaks was investigated by using primary electrons of 40, 55, and 70 mev. From the measured cross sections and the Born approximation theory the inelastic form factors can be obtained. The radiative transition probability from the excited state to the ground state gives the first point on the curve of form factor as a function of momentum transfer. In the case of C^{12} a shell-model theory of the magnetic-dipole transition gives a form-factor curve in fair agreement with the experimental results.

2599

Stanford U. High-Energy Physics Lab., Calif.

THE OBSERVATION OF A PRONOUNCED FINAL STATE INTERACTION IN THE ELECTRO-DISINTEGRATION OF THE DEUTERON, by M. R. Yearian and E. B. Hughes. [1964] [3]p. incl. diagrs. (Rept. no. HEPL-324) (AFOSR-64-1933) (Nonr-22567)
                    Unclassified

Also published in Phys. Ltrs., v. 10: 234-236, June 1, 1964.

A recent observation of the final state interaction at an incident electron energy of 146.9 mev and a laboratory scattering angle of 135° corresponding to a four-momentum transfer of 1.29 fm^{-1} is reported. The electron beam from the Stanford Mark III linear accelerator, with an energy resolution of 0.33%, was scattered from a 0.375" thin liquid deuterium target. The scattered electrons were momentum-analyzed by a 72" double-focusing magnetic spectrometer and detected by an array of ten scintillation counters located in the focal plane of the spectrometer and operated in coincidence with a single large Cerenkov counter.

2600

Stanford U. High-Energy Physics Lab., Calif.

PHOTODISINTEGRATION OF THE DEUTERON BY POLARIZED PHOTONS, by F. F. Liu. [1964] [9]p. incl. diagr. table. (Rept. no. HEPL-329) (AFOSR-65-0511) (Nonr-22567) AD 601699   Unclassified

Also published in Phys. Ltrs., v. 11: 306-307, Aug. 15, 1964.

The asymmetry in the photodisintegration of deuterons by polarized photons between 80 and 140 mev was measured at 90° in the center of mass system. The results were compared with theoretical predictions.

The asymmetry was noted to undergo a reversal in sign between photon energies of 120 and 130 mev. The data indicates that the magnetic amplitude is larger than that of presently available calculations.

2601

Stanford U. High-Energy Physics Lab., Calif.

CHARGED-PION PHOTOPRODUCTION FROM DEUTERIUM WITH POLARIZED BREMSSTRAHLUNG, by F. F. Liu, D. J. Drickey, and R. F. Mozley. July 13, 1964, 4p. (Rept. no. HEPL-330) (Nonr-22567) AD 612837   Unclassified

Also published in Phys. Rev., v. 136: B1183-B1186, Nov. 23, 1964.

Measurements were made on the ratio of pion-production cross sections at right angles to and along the photon electric-field vector. The positive and negative pions were first momentum-analyzed and counted by means of a counter telescope. Data were taken at 45, 90, and 135° in the c.m. system, and at proton energies of 225, 330, and 450 mev. A comparison of the data is made with the dispersion-relation calculation of McKinley.

2602

Stanford U. High-Energy Physics Lab., Calif.

A DETERMINATION OF RADIATIVE TRANSITIONS WIDTHS OF EXCITED STATES IN C(12), by H. L. Crannell and T. A. Griffy. July 1964, 27p. (Rept. no. HEPL-335) (Nonr-22567) AD 606401
                                                Unclassified

New absolute values for the elastic and inelastic electron scattering cross sections from C^{12} are presented for a range of q^2 from 0.75 F^{-2} to 3.14 F^{-2}. A new method of analysis has been employed to obtain the radiative widths for the first three excited states in C^{12} from the measured inelastic cross sections. This method of analysis does not depend on a model for the transition charge distribution and is useful in determining the multipolarity of the transition.

2603

Stanford U. High-Energy Physics Lab., Calif.

LINEAR ELECTRON ACCELERATOR PROJECT. Status rept. Aug. 1-Oct. 31, 1964. Nov. 1964, 42p. (Rept. no. HEPL-353) (Nonr-22567) AD 609587
                                                Unclassified

The Mark III accelerator operated with good reliability in spite of increasing frequency of the occurrence of water leaks in the rf loads. The loads are being replaced with a leak proof variety on a schedule which interferes very little with Mark III operation for research. Research with Mark II continued as usual. The Mark III electron scattering program has recently installed auxiliary magnets so that the 72in. spectrome-

ier can measure electrons scattered at 180°. With this apparatus the elastic scattering from the magnetic octupole moment of Be^9 and B^{11} has been studied as a function of momentum transfer. These experiments give for the first time a method of studying in detail the space distributions of the static magnetic moments of light nuclei.

2604

Stanford U. High-Energy Physics Lab., Calif.

NEUTRAL MESON PRODUCTION WITH POLARIZED X-RAYS, by D. J. Drickey and R. F. Mozley. [1964] [15]p. (Rept. no. HEPL-296) (Nonr-22567) AD 612836   Unclassified

Also published in Phys. Rev., v. 136: B543-B547, Oct. 26, 1964.

Measurements of neutral pion photoproduction have been made at 235, 285, 335, and 435 mev, using a beam of polarized x-rays. Using a calculated value of polarization, an analysis is made which indicates a possible need for gamma, rho, pi, or gamma, omega, pi coupling. The polarization calculations are checked by measurements made as a function of photon production angle at 335 mev.

2605

Stanford U. High-Energy Physics Lab., Calif.

QUASI-FREE ELECTRON-PROTON SCATTERING IN H3 AND He3, by A. Johansson. 1964, 23p. (Rept. no. HEPL-326) (Nonr-22567) AD 610055
                                                Unclassified

Measurements have been made of the cross sections of coincidences between scattered electrons and ejected protons, when targets of H^3 and He^3 are bombarded with 550 mev electrons. The variation of the cross-section with proton angle and proton energy has been studied for fixed electron angle and energy. The results are compared with theoretical calculations based on different three-body nuclear wave functions.

2606

Stanford U. Inst. for Mathematical Studies in the Social Sciences, Calif.

EMPIRICAL COMPARISON OF MODELS FOR A CONTINUUM OF RESPONSES WITH NONCONTINGENT BIMODAL REINFORCEMENT, by P. Suppes, H. Rouanet and others. [1964] [21]p. incl. diagrs. tables. (AFOSR-64-2500) (AF 49(638)1037) AD 453964
                                                Unclassified

Also published in Studies in Math. Psychol., 1964, p. 358-379.

The aims of the present experiment have been twofold. The first has been to investigate the extent to which the common predictions of the linear and stimulus

sampling models for a continuum of responses will hold when the reinforcement distribution is no longer unimodal as it was in the case of the Suppes and Frankmann study. Secondly, a larger number of trials was run in this study than in the Suppes and Frankmann study in order to provide an adequate amount of data at asymptote to test the differential sequential predictions of the linear and stimulus-sampling models. In the Suppes and Frankmann and the Suppes and Rouanet studies, no predictions are reported that differentiate the two kinds of models.

2607

Stanford U. Inst. for Mathematical Studies in the Social Sciences, Calif.

A SIMPLE DISCRIMINATION EXPERIMENT WITH A CONTINUUM OF RESPONSES, by P. Suppes and H. Rouanet. [1964] [41]p. incl. diagrs. tables, refs. (AFOSR-64-2501) (AF 49(638)1037) AD 453965
Unclassified

Also published in Studies in Math. Psychol., 1964, p. 317-357.

This paper reports tests of several stochastic learning models for a continuum of responses in a simple discrimination experiment. The basic models are formulated in Suppes (1959, 1960). The only previous experiment in the literature directly testing these models, reported by Suppes and Frankmann (1961), is concerned with a simple learning situation with unimodal noncontingent determinate reinforcement. They describe their experiment as follows: The subject is told that his task on each trial is to predict by means of a pointer where a spot of light will appear on the circumference of a circle: the subject's responses are his pointer predictions. At the end of each trial the "correct" position of the spot is shown to the subject; this is the reinforcing event for the trial. The response x and the reinforcement y vary continuously along the circle from 0 to 2π.

2608

Stanford U. Inst. for Mathematical Studies in the Social Sciences, Calif.

A PROBABILISTIC MODEL FOR FREE-RESPONDING, by M. F. Norman. Dec. 14, 1964, 99p. (Technical rept. no. 67) (AFOSR-65-0288) (AF AFOSR-62-384) AD 611163
Unclassified

A free-responding (or 'free-operant') situation is one in which an organism is permitted to perform (or 'emit') a certain action (or 'response' or 'operant') repeatedly, at any times it chooses. In the free-operant situations considered in this paper, an animal (typically a rat or pigeon) is induced to perform this action (usually a lever press in the former case and a peck at a specified area or 'key' in the latter) by being tendered a reward (or 'positive) reinforcement'—a small amount of food, for instance, occasionally, after the action is performed. B. F. Skinner, Behavior of Organisms, New York, Appelton-Century-Crofts,

discovered that various reward regimes (or 'schedules of reinforcement') generate distinctive behavior patterns in free-responding situations. Interest is centered around this phenomenon.

2609

Stanford U. Microwave Lab., Calif.

NOISE AND CORRELATION STUDIES OF MICROWAVE RESONANCES OF A PLASMA COLUMN IN A MAGNETIC FIELD, by G. N. Oetzel. Oct. 1964, 145p. incl. illus. diagrs. refs. (AFOSR-64-2494) (AF 49(638)1321) AD 615553
Unclassified

Recent observations of strong resonances at the harmonics of the electron cyclotron frequency in the noise emission from low temperature plasmas have raised the question of whether the harmonics were being generated in the volume of the plasma or in the sheath. This work presents conclusive evidence that the observed harmonic effects can be explained satisfactorily in terms of electrostatic oscillations in the plasma volume, and that they cannot be explained in terms of effects in the sheath.

2610

Stanford U. [Microwave Lab.] Calif.

GRAVITATIONAL INSTABILITIES IN A COMPRESSIBLE COLLISIONAL PLASMA LAYER, by B. Coppi. Oct. 1964 [27]p. incl. refs. (AFOSR-65-0393) (AF 49(638)-1321) AD 612342
Unclassified

Also published in Ann. Phys., v. 30: 178-200, Oct. 1964.

The stability of a plasma layer under the influence of a gravitational field, in conditions where all the dissipative effects due to collisions are important, is investigated by proper asymptotic methods. Small ratios of the kinetic to the magnetic pressure and regimes where the ion Larmor radius effects are not relevant are considered.

2611

Stanford U. [Microwave Lab.] Calif.

ADDENDUM ON INERTIAL INTERCHANGE MODES, by B. Coppi. [1964] [2]p. (AFOSR-65-0394) (AF 49(638)-1321) AD 612225
Unclassified

Also published in Phys. Ltrs., v. 12: 213-214, Oct. 1, 1964.

An earlier study of electron inertia effects on plasma stability (Phys. Ltrs., v. 11: 226, 1964) gave only the resistive unstable branch of the interchange mode growth rates as significant. This was due to an inconsistency of the ordering process. The present paper gives a consistent consideration and derives a general dispersion relation which has the earlier determined collisional and collisionless analyses as special cases.

2612

Stanford U. [Microwave Lab.] Calif.

ELECTRON OVERTAKING AS A CAUSE OF INSTA-
BILITY AND TYPE III SOLAR RADIO BURSTS, by D.
E. Baldwin. [1964] [2]p. (AFOSR-65-0395) (AF 49-
(638)1321) AD 612224   Unclassified

Also published in Phys. Ltrs., v. 12: 202-203, Oct. 1,
1964.

It is the purpose of this note to suggest a mechanism
whereby a time-dependent source of electrons in an
otherwise uniform stable plasma may give rise to
electrostatic instabilities even though no beam is gen-
erated by the source.

2613

Stanford U. [Microwave Lab.] Calif.

STRUCTURE OF THE SOLAR CHROMOSPHERE, by
P. A. Sturrock. [1964] [2]p. incl. diagr. (Rept. no.
ML-1167) (AFOSR-65-1077) (AF 49(638)1321)
AD 617852   Unclassified

Also published in Nature, v. 203: 285-286, July 13,
1964.

It is generally accepted that the radially increasing
temperature of the solar atmosphere is due to propaga-
tion of non-thermal energy. The possibility that the
sun's magnetic field has any significant effect has been
discredited, and this note investigates the solar chro-
mosphere structure theoretically by considering acous-
tic waves only. It is suggested that the strength of these
waves may be a result of their build-up into shock
waves, though this paper departs from the usual assump-
tion that acoustic waves of arbitrarily small amplitudes
will form shocks. It is assumed here that a wave forms
a shock only if $M \sim 1$. The model presented enables
one to understand the sharp transition from the chro-
mosphere to the corona.

2614

Stanford U. [Microwave Lab.] Calif.

A NEW MODEL OF SOLAR FLARES, by P. A.
Sturrock and B. Coppi. [1964] [2]p. incl. refs.
(AFOSR-65-1078) (AF 49(638)1321) AD 619754
          Unclassified

Also published in Nature, v. 204: 61-62, Oct. 3, 1964.

A model of a solar flare is set up opposing theories
which assume that the mechanism for energy storage
is purely magnetic. Because of the high density of the
gas envolved, gravitational potential energy is con-
sidered as an alternative or complementary form.
The pre-flare configuration is visualized as a dense
layer of cool gas supported by and compressing a mag-
netic field. Homologous flares are explained by pro-
posing a mechanism for the slow build-up of such a
configuration, which will at some stage become un-

stable. This instability must be such as to allow the
magnetic field to return to its unstressed state. The
build-up of such a configuration is further explained.

2615

Stanford U. [Microwave Lab.] Calif.

TEMPERATURE DEPENDENCE OF THE WIDTH
AND POSITION OF THE $^2E - ^4A_2$ FLUORESCENCE
LINES OF Cr^{3+} AND V^{2+} IN MgO, by G. F. Imbusch,
W. M. Yen and others. [1964] [6]p. incl. diagrs. refs.
(AFOSR-64-0906) (AF AFOSR-62-343) AD 439861
          Unclassified

Also published in Phys. Rev., v. 133: A1029-A1034,
Feb. 17, 1964.

This paper reports measurements of the width and
positions of the sharp fluorescence lines of two ions in
MgO between 4.2°K and room temperature. A semi-
empirical model is used to calculate the temperature
dependence of the width and position from the vibrational
structure associated with the sharp no-phonon line.
The shift agrees well with theory but the linewidth devi-
ates somewhat at low temperatures. (Contractor's
abstract, in part)

2616

Stanford U. [Microwave Lab.] Calif.

THE HIGH GAIN LASER AS A WAVELENGTH
STANDARD, by L. F. Mollenauer, G. F. Imbusch
and others. [1963] [16]p. incl. illus. diagrs. refs.
(M.L. rept. no. 1139) (AFOSR-64-0907) (AF AFOSR-
63-322) AD 433118   Unclassified

Presented at Symposium on Optical Masers,
Polytechnic Inst. of Brooklyn, N. Y., Apr. 16-19, 1963.

The requirements for monochromaticity and stability of
an optical maser are discussed. Two methods are
shown for obtaining output at the center of the spontane-
ous emission line. The first uses strong anomalous
dispersion to pull oscillation of a single cavity mode
close to the atomic line center. By using a short cavity
with low reflectivity ends, and a sufficiently sharp
atomic line, the output frequency is made highly inde-
pendent of the cavity dimensions. The second, intended
as a convenient secondary frequency standard for spec-
troscopic work, uses the effective line narrowing created
by high overall gain to select mode frequencies at the
line center for oscillation at threshold. Such a device,
using a clad ruby rod immersed in liquid nitrogen, and
without adjustments, has generated a single line whose
stability and width are better than two parts in 10^7.
(Contractor's abstract)

2617

Stanford U. Microwave Lab., Calif.

NONLINEAR EFFECTS IN LONGITUDINAL ELECTRON-
STREAM SLOW-WAVE GUIDE SYSTEMS, by G. C.

Van Hoven. Apr. 1963 [97]p. incl. illus. diagrs. tables, refs. (M. L. rept. no. 1026) (AFOSR-4878) (Nonr-22548)   Unclassified

This monograph presents an experimental demonstration of two heretofore unobserved nonlinear effects in systems supporting space-charge waves. The discussion is based on a physical theory which exhibits second order coupling of these waves to those supported by an external circuit. This new interaction makes possible the control of idler harmonic dispersion and, thus, removes a major obstacle to the design of a successful parametric amplifier using space-charge waves. The most important prediction of this theory is the possibility, which has been verified, of removing negative energy kinetic excitation from the slow space-charge wave. The physical theory, a perturbation analysis in displacement variables, describes all possible second order nonlinear interactions. A small signal power theorem, applicable to three frequency excitation, is derived from the dynamical equations. The conditions, restricting the location of higher idler harmonics, under which this simplification is justified are discussed.

2618

Stanford U. Microwave Lab., Calif.

THE THEORY AND APPLICATION OF SOME TRANS-VERSE-WAVE INTERACTIONS, by R. E. Hayes. Apr. 1963, 207p. (Technical rept. no. 1025) (AFOSR-4965) (Nonr-22548) AD 404098   Unclassified

The results of a theoretical and experimental investigation of transverse-wave couplers, and of frequency doublers employing these couplers in conjunction with a resonant quadrupole circuit, are described. The theory of both traveling-wave and resonant couplers is developed in detail so that the significant characteristics of the coupling interactions are described in terms of known quantities. The coupled mode theory was extended to include twisted transverse-wave couplers with a resulting clarification of this important class of interactions. The theory shows that the traveling-wave couplers may have a large bandwidth but generally tend to be quite long due to the low interaction impedance characterizing this type of circuit.

2619

Stanford U. Microwave Lab., Calif.

NONLINEAR QUANTUM EFFECTS, by R. C. Smith. Apr. 1963 [174]p. incl. diagrs. refs. (M. L. rept. no. 1027) (AFOSR-4966) (Nonr-22548) AD 405521   Unclassified

The purpose of this research was to study the phenomena of multiple quantum processes and to consider possible applications. These processes involve the interaction of more than a single quantum of radiation with an atomic system and are nonlinear in character. An equation of motion approach is used in the solution of the quantum mechanical problem, allowing the calculation of the observable quantities important for the

radiation processes considered. From the results of this research it is thus concluded that a quantum mechanical system possesses nonlinear as well as linear properties and that these nonlinear properties may find application, especially in the submillimeter and optical regions where suitable nonlinear elements do not presently exist.

2620

Stanford U. Microwave Lab., Calif.

HARMONIC GENERATION IN PLASMAS, by J. H. Krenz. July 1963 [148]p. incl. illus. diagrs. refs. (M. L. rept. no. 1055) (AFOSR-64-0348) (Nonr-22548)   Unclassified

The generation of harmonics due to the nonlinear properties of a microwave plasma discharge is investigated theoretically and experimentally. The nonlinear effects of collisions, spatial variations of rf electric field and plasma density, and sheaths are analyzed. With the objective of developing and an efficient harmonic generator and understanding the basic discharge mechanisms, various experimental techniques and configurations are explored. (Contractor's abstract)

2621

Stanford U. Microwave Lab., Calif.

THE THEORY OF DIRECT TRANSITIONS IN SEMI-CONDUCTORS, by R. H. Pantell, M. DiDomenico, Jr. and O. Svelto. Jan. 1964 [23]p. (M. L. rept. no. 1131) (AFOSR-64-0349) (Nonr-22548) AD 431112   Unclassified

The problem of direct interband transitions in semi-conducting crystals is considered in detail. The solution of the problem is shown to lead to a system of simultaneous coupled nonlinear differential equations. These equations do not distinguish between static and dynamic fields, and are obtained without recourse to any approximation procedures. They therefore apply for electromagnetic fields of arbitrary amplitude. It is shown, finally, that the linearization of these equations correctly predicts the fundamental optical edge and the photoconductive rate equations which result in photomixing phenomena.

2622

Stanford U. Microwave Lab., Calif.

FAR INFRARED STUDY OF OPTICAL MODES AND INDEX OF REFRACTION IN CADMIUM SULFIDE, by B. Lebech. Nov. 1963 [37]p. incl. diagrs. table, refs. (M. L. rept. no. 1108) (AFOSR-64-0352) (Nonr-22548)   Unclassified

The purpose of this work was to investigate the optical modes by some simple means in piezoelectric and polar crystal. A spectrometer was used to investigate CdS in the region near the reststrahlung frequency. The primary results which are presented here show that

the measured index of refraction (n ~ 2.1) in the range from 50 to 150μ is consistent with the single resonance of the transverse optical mode at 41.5μ.

2623

Stanford U. Microwave Lab., Calif.

THE EFFECT OF HOLE MOBILITY ON ACOUSTIC WAVE AMPLIFIERS, by K. Blotekjaer. Aug. 1963 [26]p. incl. diagrs. (M.L. rept. no. 1072) (AFOSR-64-0627) (Nonr-22548)   Unclassified

Acoustic waves can be amplified by interaction with drifting electrons in piezoelectric semiconductors. Amplifiers built on this principle tend to be unstable, because waves reflected from inhomogeneities or a mismatched output propagate in the backward direction with very little attenuation. It is shown in the present paper that the backward attenuation can be increased substantially by allowing the reflected waves to interact with drifting holes. The propagation characteristics of the waves on the drifting electrons and holes are discussed, and numerical calculations are carried out to show that the presence of the holes tends to stabilize the amplifier. The proposed scheme requires a piezoelectric semiconductor with high intrinsic conductivity.

2624

Stanford U. Microwave Lab., Calif.

TILTED-PLATE INTERFEROMETRY WITH LARGE PLATE SEPARATIONS, by H. W. Moos, G. F. Imbusch and others. Sept. 1963 [6]p. incl. illus. diagr. refs. (M.L. rept. no. 1083) (AFOSR-64-0528) (Nonr-22548) AD 418621   Unclassified

Also published in Appl. Opt., v. 2: 817-822, Aug. 1963.

With very highly collimated monochromatic light sources, such as optical masers, multiple-beam interference fringes between nearly parallel surfaces are obtained at large separations. Sharp fringes displaying the surface contours have been observed as large as 20 cm. The requirements and limitations of the device are described, as well as some possible applications. (Contractor's abstract)

2625

Stanford U. Microwave Lab., Calif.

INTERACTION OF ACOUSTIC WAVES AND ELECTRIC CURRENTS IN SOLIDS, by A. Tonning. Aug. 1963 [25]p. incl. diagr. (M.L. rept. no. 1068) (AFOSR-64-0630) (Nonr-22548) AD 417719   Unclassified

On the basis of Boltzmann's transport equation an expression is derived for the space-charge modulation in a current-carrying solid when a periodically varying force is acting on the electrons. The force may be caused by an acoustic wave interacting with the electrons through the deformation potential or through the

piezoelectric effect. These two special cases are discussed and the condition for obtaining amplification of the acoustic wave is derived. The high-frequency properties of the two interaction mechanisms are studied. In an appendix it is shown that the deformation potential mechanism may be described by two linear equations similar to the well-known piezoelectric equations. (Contractor's abstract)

2626

Stanford U. Microwave Lab., Calif.

THE COUPLED MODES OF ACOUSTIC WAVES AND DRIFTING CARRIERS IN PIEZOELECTRIC CRYSTALS, by K. Blotekjaer and C. F. Quate. July 1963 [67]p. incl. diagrs. refs. (M.L. rept. no. 1057) (AFOSR-64-0807) (Nonr-22548)   Unclassified

The amplification of acoustic waves in piezoelectric semiconductors is analyzed in terms of the normal modes of the uncoupled system. The characteristics of the growing wave are presented for a range of the crystal parameters in terms of the conduction frequency (σ/ϵ) and the diffusion frequency (v^2/D). Boundary conditions are worked out to show that an acoustic wave at the input to the amplifying section will couple into the growing wave without appreciable initial loss. The experimental results with CdS at 600 mc confirm the general features of the theory and serve to point out the problems which must be overcome.

2627

Stanford U. Microwave Lab., Calif.

PHOTOMIXING IN A BULK SEMICONDUCTOR PHOTO-DETECTOR, by J. N. Weaver. Aug. 1964 [65]p. incl. diagrs. tables, refs. (M.L. rept. no. 1206) (AFOSR-64-1903) (Nonr-22548)   Unclassified

This study is concerned with bulk semiconductors as detectors of the difference frequency between two or more optical signals and as a demodulator of microwave AM modulated light. The basic experiment consisted of mounting single crystals of CdSe, Si, and GaAs in a coaxial mount and illuminating the crystals with the beam of a single laser, which consisted of numerous frequencies separated by multiples of ω_D (ω_D = 1.32 Gc). A dc bias voltage was applied and the microwave and dc photocurrents were measured as a function of light intensity, bias voltage, temperature, microwave match, and the various crystal samples. An outline of the pertinent, simplified photoconductor theory is presented along with an equivalent circuit for the photodetector device. Also, the semiconductor capture cross section, lifetime, and trap density is calculated from the measured values of photocurrent.

2628

Stanford U. Microwave Lab., Calif.

A LINEAR ELECTRON ACCELERATOR FOR SUB-MILLIMETER WAVE GENERATION, by R. H. Miller.

Oct. 1964 [132]p. incl. diagrs. tables, refs. (M. L. rept. no. 1244) (AFOSR-65-0250) (Nonr-22548) AD 610190   Unclassified

The use of a relativistic beam of electrons for the generation of submillimeter waves in large interaction structures was investigated as a possible alternative to the scaling of conventional microwave generators to the extremely small dimensions required. The design of an x-band linear accelerator for production of a beam having high harmonic current content is discussed, and various methods of achieving good bunching are considered. A small angle theory of bunching in a distributed buncher is developed and used as a guide in the design of the buncher section of the accelerator. A new microwave measurement technique for measuring field strength and phase in nonresonant structures was used to determine the electrical properties of the buncher. The effect of auxiliary equipment on the operation of the distributed buncher and accelerator is evaluated.

2629

Stanford U. Microwave Lab., Calif.

STUDY OF PARALLEL PUMPING IN MICROWAVE FERRITES, by M. Omori. Dec. 1964 [170]p. incl. illus. diagrs. tables, refs. (M. L. rept. no. 1275) (AFOSR-65-1139) (Nonr-22548)   Unclassified

Some aspects of the degenerate pumping in a microwave ferrite along with the degenerate pumping in a pendulum and an electrical tuned circuit were theoretically and experimentally investigated. The studies were divided mainly into two parts, one being the study below the parallel pump instability threshold, and the other being the study above the threshold. When the pump strength is below the threshold, there are no parametric oscillations and the pumped system responds passively to the signal, whose frequency is the half of that of the pump. When the pump strength is above the threshold, there will be parametric oscillations and, as the oscillation builds up, nonlinearities of the system become effective and the oscillation reaches steady state.

2630

Stanford U. Microwave Lab., Calif.

MICROWAVE RESEARCH. Quarterly status rept. no. 22, May 1-July 31, 1964. Oct. 1964, 33p. (M. L. rept. no. 1235) (Nonr-22548) AD 608506   Unclassified

At the present time there are seven projects active under this contract: 1. Acoustic wave amplification studies; 2. Optical masers; 3. Diffraction of light waves by hypersound; 4. Transient effects in optical masers; 5. Electron-phonon interactions; 6. Interaction of spin waves and electrons; 7. Geometrical optics of acoustic waves.

2631

Stanford U. [Radio Astronomy Inst.] Calif.

INTERFEROMETER PHASING PROBLEMS AT MICROWAVE FREQUENCIES, by G. Swarup and K. S. Yang. 1963 8p. (AFOSR-J291) (AF 18(603)53) AD 408014   Unclassified

The electric field distribution required to realize a desired radiation pattern is sometimes quickly visualized by means of a transfer function (the spectral sensitivity function) which measures the response of the antenna system to the spatial frequencies of a two-dimensional distribution of brightness. The effects of amplitude and phase errors of individual elements on the directivity and side radiation pattern of an interferometer system are discussed. In the case of phase-switched interferometers it is also important to evaluate the effect of fixed phase error of the switch and feeder system, and phase throw error of the switch, on the radiation pattern. It is shown that these phase errors affect the shape of the radiation pattern only if there exists an odd component in the two-dimensional electric field distribution over an aperture.

2632

Stanford U. [Radio Astronomy Inst.] Calif.

OBSERVATIONS AT 9.1 CM OF TAURUS A, THE ORION NEBULA, VIRGO A, CENTAURUS A, SAGITARRIUS A, AND THE OMEGA NEBULA, WITH 2.3 FAN BEAM, by A. G. Little. [1963] [11]p. (AFOSR-J733) (AF 18(603)53) AD 414147   Unclassified

Also published in Astrophys. Jour., v. 137: 164-174, 1963.

Fan-beam observations of several of the stronger radio sources were made, using a wide-band parametric amplifier connected to the Stanford microwave spectro-heliograph. All sources were scanned in the east-west direction at meridian transit. For the two sources Taurus A and Virgo A the north-south antenna was used to provide two additional scanning directions. From these, the Taurus A source is found to be an ellipse while the Virgo A radiation comes from a narrow region away from the position angle of the jet. The central source of Centaurus A is found to be split into two regions, while the Orion Nebula and Sagittarius A are simple sources. The Omega nebula is shown to have a weak source located at the optical center of the nebula and a strong source to the west. The observed transit times of the maxima are also given.

2633

Stanford U. [Radio Astronomy Inst.] Calif.

RESOLUTION OF CYGNUS A WITH A 52" BEAM, by G. Swarup, A. R. Thompson, and R. N. Bracewell. Feb. 1963, 13p. (AFOSR-4655) (AF 49(638)1059) AD 408484   Unclassified

Direct resolution of Cygnus A at a frequency of

3292 mc/s using the 52 in. fan beam of a compound interferometer is reported. On the basis of a firm determination of the actual peak-to-peak distance the existing data were examined and it was found that the reported dependence of separation on frequency is simply an appearance produced by the existence of a third-component whose spectrum differs from that of the main components.

2634

Stanford U. Radio Astronomy Inst., Calif.

HIGH-RESOLUTION OBSERVATIONS OF THE RADIO SUN AT 9.1 CENTIMETERS ON JULY 20, 1963, by H. K. Asper, R. N. Bracewell and others. [1964] [3]p. incl. diagrs. (AFOSR-65-2255) (AF 49(638)1059)
Unclassified

Also published in Jour. Geophys. Research, v. 69: 1805-1807, May 1, 1964.

The 9.1-cm radio sun at the time of the eclipse of July 20, 1963, had two radio plages. One, of moderate importance, was located near the east limb at $56° \pm 2°E$ and $10° \pm 2°N$. It had a flux density of about 5×10^{-22} watt m^{-2} $(c/s)^{-1}$ and an angular size in the east-west direction of $1.5'$. The brightness temperature was 1×10^6 °K (effective value for a uniform circular source $1.5'$ in diameter). The other was of much lower intensity and was located near the west iimb at $80° \pm 10°W$ and $4° \pm 2°N$. Its flux density was about 2×10^{-22} watt m^{-2} $(c/s)^{-1}$, and its size less than $3.5'$ in both north-south and east-west directions. (Contractor's abstract)

2635

Stanford U. Radio Astronomy Inst. Calif.

THE STANFORD COMPOUND-GRATING INTERFEROMETER, by J. S. Picken and G. Swarup. [1964] [4]p. incl. illus. diagrs. refs. (AFOSR-65-2257) (AF 49(638)1059) AD 625991 Unclassified

Also published in Astronom. Jour., v. 69: 353-356, June 1964.

A compound interferometer of high angular resolving power in one coordinate has been constructed at Stanford using the E-W arm of the existing cross antenna. The instrument produces multiple fan beams 52" E-W by 2.3°N-S at 9.1-cm wavelength. It is capable of observing the size and percentage of circular polarization of solar radio plages, the solar disk, and galactic and extragalactic radio sources.

2636

Stanford U. Stanford Electronics Labs., Calif.

WHISTLER-MODE PROPAGATION DATA NO. 2, by D. L. Carpenter and G. B. Carpenter. Jan. 1963,

13p. incl. tables, refs. (Technical rept. no. 1112-1; rept. no. SEL-63-006) (AFOSR-4929) (AF 49(638)1060)
Unclassified

Routine data on whistler dispersion and on whistler-mode echoes from VLF-pulse transmissions are tabulated. The whistler data were obtained at Stanford, Calif., at Seattle, Wash., and at Logan, Utah. Data are sampled on a daily basis. The times of occurrence, values of dispersion at 5 kc, and the frequency and travel time at the whistler nose are tabulated. Data on whistler-mode echoes from VLF station NPG (Jim Creek, Wash., 18.6 kc) were obtained at Stanford, Calif. Hourly values of two-hop echo travel time, activity index, and quality factor for the period Nov. 1 to Dec. 31, 1961 are tabulated.

2637

Stanford U. Stanford Electronics Labs., Calif.

STUDY OF NATURAL AND MAN-MADE VLF PHENOMENA. Final rept. Aug. 1, 1962-July 31, 1963, 7p. (AFOSR-J1392) (AF 49(638)1060) AD 428348
Unclassified

The study of natural and man-made VLF phenomena is described under these headings: (1) whistler-mode propagation; (2) magnetosphere electron density studies using whistlers; and (3) wave-particle interactions. A brief description is given of most of the work since details are available in reports and publications listed in an attached bibliography. In addition to the bibliography of published material there is a list included which deals with papers presented at technical meetings and symposia.

2638

Stanford U. Stanford Electronics Labs., Calif.

WHISTLERS EXCITED BY NUCLEAR EXPLOSIONS, by R. A. Helliwell and D. L. Carpenter. [1963] [12]p. incl. illus. diagrs. table, refs. (AFOSR-64-0307) (AF 49(638)1060) AD 424531 Unclassified

Also published in Jour. Geophys. Research, v. 68: 4409-4420, Aug. 1, 1963.

The dynamic spectrums of whistlers excited by five nuclear explosions are found to be identical to those of natural whistlers observed within a few minutes of shot time. Two shots fired at the Nevada proving ground produced normal two-hop whistlers at Stanford, 600 km to the west. Three shots fired over Johnston Island produced one-hop whistlers, some of which were received at northern hemisphere stations as far away as Stanford, 5100 km to the northeast. No whistlers were observed on Kauai, only 1200 km northeast of Johnston Island. Analysis shows that the magnetospheric paths of natural and explosion-excited whistlers are essentially the same, and that these paths are fixed in the ionosphere and are not necessarily close to the impulse source or the receiver.

2639

Stanford U. [Stanford Electronics Labs.] Calif.

PLASMA INSTABILITY IN THE WHISTLER MODE
CAUSED BY A GYRATING ELECTRON STREAM, by
T. F. Bell and O. Buneman. [1964] [3]p. (AFOSR-64-
1376) (AF 49(638)1060) AD 444472   Unclassified

Also published in Phys. Rev., v. 133: A1300-A1302,
Mar. 1964.

Excitation of the whistler (electromagnetic) mode in
a cold plasma immersed in a static magnetic field can-
not be achieved by monoenergetic electrons initially
streaming parallel to the field lines, since for this
case gyroresonance can occur only when the stream
direction is opposed to the direction of the wave, and
as demonstrated by Neufeld, the beam will then fail to
transfer energy to the wave. However, for streams
with finite initial transverse velocity the analysis of
Neufeld must be modified, and it is found that a spread
of stream electron velocity in the transverse direction
leads to an instability of the stream-plasma system in
the whistler mode, with the transverse electron gyra-
tions serving . s an energy source.

2640

Stanford U. Stanford Electronics Labs., Calif.

TIME REVERSAL OF THE GEOCYCLOTRON
MECHANISM, by T. F. Bell. [1964] [3]p. (AFOSR-
65-1389) (AF 49(638)1060) AD 622645
                                            Unclassified

Also published in Jour. Geophys. Research, v. 69:
177-179, Jan. 1, 1964.

A possible method is outlined for removing high-
energy particles from natural or artificially produced
radiation belts. In essence it is the time of reversal
of the geocyclotron mechanism, and its object is to
de-energize high-energy electrons by means of gyro-
resonance, a phenomenon in which electrons in the
earth's outer ionosphere are decelerated by frequency-
modulated, circularly polarized electromagnetic waves
generated on the ground. A simple numerical example
of the use of such a model is presented, and it is con-
cluded that such a method is possible for the removal
of high-energy particles from radiation belts.

2641

Stanford U. Stanford Electronics Labs., Calif.

OPTICAL-MASER AND COHERENT-PLASMA
STUDIES, by W. W. Anderson, O. Buneman, and A. E.
Siegman. Final rept. June 1963, 7p. incl. diagrs.
(Rept. no. SEL-63-080) (AFOSR-J1302) (AF AFOSR-
62-286)   Unclassified

The work under this contract has included far-infrared
maser studies by Professor Siegman, studies of rare-
earth ions in semiconductor lattices by Professor
Anderson, and plasma studies by Professor Buneman.

2642

Stanford U. [Stanford Electronics Labs.] Calif.

PHOTOLUMINESCENT PROPERTIES OF RARE
EARTH DOPED II-VI COMPOUNDS (Abstract), by W.
W. Anderson. [1964] [1]p. (AF AFOSR-62-286)
                                            Unclassified

Presented at Toronto meeting of the Electrochem. Soc.,
Canada, May 3-7, 1964.

The emission lines of Tb^{+++} and Nd^{+++} in ZnS are
strong narrow (less than 3A wide) at 77°K. Evidence
for indirect excitation of the 4f electronic system of the
rare earth ions is the presence of the characteristic
narrow emission lines even when the exciting illumina-
tion is of higher energy than the II-VI compound band gap
and the presence of the dark lines in the broad band
emission of Nd doped CdS corresponding to the
$^4_{9/2} - ^4F_{3/2}$ transition of Nd^{+++}

2643

Stanford U. [Stanford Electronics Labs.] Calif.

FUNCTIONAL NETWORK ANALYSIS AND SYNTHESIS,
by R. W. Newcomb and D. A. Spaulding. Aug. 28,
1963, 32p. (AFOSR-J1208) (AF AFOSR-62-349)
AD 424272   Unclassified

The primary motivation for this research has been to
obtain analysis and synthesis methods for time-varying
networks through functional techniques. The original
attempts were to generalize Mikusinski's operational
calculus to a form usable for time-varying networks.
Although this still seems possible, these attempts led
to investigations of zero-divisors (in an algebra based
upon Volterra composition), which in turn led to the
discovery of a time-variable scattering matrix. This
research has shown that every linear, passive, solvable
network has such a scattering matrix, and several of the
key properties have been obtained.

2644

Stanford U. [Stanford Electronics Labs.] Calif.

THE FOUNDATIONS OF NETWORK THEORY, by R.
W. Newcomb. [1964] [6]p. incl. diagrs. refs. (AFOSR-
64-1732) (AF AFOSR-62-349 and Nonr-22524)
AD 448276   Unclassified

Also published in Trans. Elec. and Mech. Eng., May
1964, p. 7-12.

This paper outlines a rigorous theory of networks,
set up with the synthesis of time-varying networks in
mind. Although the definitions of network properties
given hold when considering any type of network, they
should not be looked upon as the only possible ones or
even the most appropriate. For instance it may be
desirable to generalize the notion of solvability such that
it is more meaningful for nonlinear networks. In any
event, using the notions given, very general results con-
cerning time-variable networks can be obtained.

2645

Stanford U. Stanford Electronics Labs., Calif.

AN FM TECHNIQUE FOR OBSERVATION OF VLF
WHISTLER-MODE PROPAGATION, by G. B.
Carpenter. Dec. 1963, 52p. incl. illus. diagrs. refs.
(Technical rept. no. 3412-2; rept. no. SEL-63-133)
(AFOSR-64-0002) (AF AFOSR-62-370) AD 429891
Unclassified

The usefulness of whistlers is somewhat restricted by
the relative lack of information concerning lightning-
source parameters, while relatively poor multipath
resolution has been obtained using the signals of VLF
transmitters. A controlled-source experiment intended
to overcome these disadvantages is described in this
report. The FM technique for detecting and resolving
whistler-mode signals is based on the observation of
amplitude modulation of the direct subionospheric sig-
nal due to the presence of whistler-mode signals.
Travel time of the whistler-mode signal is shown to be
associated with the periodicity of the envelope changes
of the composite signal. Factors such as signal dis-
persion, value of modulation parameters, and instru-
mental effects are considered with regard to their in-
fluence on detection and resolution. An actual FM ex-
periment is described.

2646

Stanford U. Stanford Electronics Lab., Calif.

ARTIFICIALLY STIMULATED VERY-LOW-FRE-
QUENCY RADIATION FROM THE IONOSPHERE, by
R. A. Helliwell, J. Katsufrakis and others. [1964]
[4]p. incl. illus. table. (AFOSR-64-1369) (AF AFOSR-
62-370) Unclassified

Also published in Jour. Geophys. Research, v. 69:
2391-2394, June 1, 1964.

In the course of experimental studies of whistlers and
related ionospheric effects conducted by Stanford
University, a new phenomenon has been discovered.
It is the triggering of VLF emissions in the ionosphere
by whistler-mode signals transmitted from VLF stations
operated by the U. S. Navy. Certain important features
of this phenomenon are reported.

2647

Stanford U. Stanford Electronics Labs., Calif.

THE DISTRIBUTION OF IONS AND ELECTRONS IN
THE EARTH'S EXOSPHERE, by J. J. Angerami and
J. O. Thomas. Dec. 1963, 94p. incl. diagrs. tables,
refs. (Technical rept. no. 3412-3; rept. no. SEL-63-
110) (AFOSR-64-1370) (AF AFOSR-62-370)
AD 604040 Unclassified

The factors which govern the distribution of electrons
and ions in the earth's exosphere are discussed. The
theory takes into account the effect of the electric
field which arises from charge separation, the
centrifugal force arising from the rotation of the earth

and the effect of the earth's gravitational field. It is
assumed that the charged particles are constrained to
move only along the direction of the earth's magnetic
lines of force. The modifications that result in the
electron and ion distributions when a temperature varia-
tion is assumed along a line of force are also con-
sidered. (Contractor's abstract, in part)

2648

Stanford U. Stanford Electronics Labs., Calif.

WAVE PARTICLE GYRORESONANCE INTERACTIONS
IN THE EARTH'S OUTER IONOSPHERE, by T. F.
Bell. May 1964, 214p. (Technical rept. no. 3412-5;
rept. no. SEL-64-065) (AFOSR-64-1908) (AF AFOSR-
62-370) AD 607379 Unclassified

An investigation is presented of certain aspects of those
gyroresonance interactions which take place between
very low frequency VLF electromagnetic waves and
charged particle fluxes in the earth's outer ionosphere.
Specifically two problems are considered. The first
problem involves the stability of the outer ionosphere
plasma to whistler-mode waves under conditions in
which high energy electron fluxes permeate this plasma.
The second problem involves the feasibility of the crea-
tion or depletion of an artificial radiation belt utilizing
the geocyclotron gyroresonance interaction in order to
transfer energy between man-made waves and relativ-
istic electrons trapped in the outer-ionosphere by the
earth's magnetic field near the magnetic equatorial
plane.

2649

Stanford U. Stanford Electronics Labs., Calif.

STUDY OF NATURAL AND MAN-MADE VLF PHE-
NOMENA, by D. L. Carpenter. Final rept. Aug. 1,
1963-July 31, 1964. Oct. 1964, 14p. (AFOSR-64-
2067) (AF AFOSR-62-370) AD 608595 Unclassified

Three principal areas of investigation are reviewed:
(1) whistler mode propagation, (2) magnetospheric
electron density studies using whistlers, and (3) wave-
particle interactions.

2650

Stanford U. [Stanford Electronics Labs.] Calif.

WHISTLER MEASUREMENTS OF ELECTRON DENSITY
IN THE MAGNETOSPHERE, by D. L. Carpenter and
R. L. Smith. [1964] [17]p. incl. illus. diagrs. refs.
(AFOSR-64-2222) (AF AFOSR-62-370) AD 452391
Unclassified

Also published in Rev. Geophys., v. 2: 415-441, Aug.
1964.

The whistler method of measuring electron density in
the magnetosphere is discussed. Particular attention
is devoted to certain questions that may have been
perplexing to workers outside the whistler field.

Profiles of equatorial electron density deduced from whistlers are compared and are found to be in general agreement. Whistler results on the 'knee' in the equatorial electron density profile and on values of electron density near 2 earth radii geocentric distance are found to agree with corresponding results obtained by independent methods of measurement. (Contractor's abstract)

2651

Stanford U. Stanford Electronics Labs., Calif.

ASSOCIATION BETWEEN VLF EMISSIONS AND FLICKERING AURORA, by E. Ungstrup. June 1964, 4p. incl. illus. table. (Technical rept. no. 3412-4; rept. no. SEL-64-050) (AFOSR-64-2223) (AF AFOSR-62-370) AD 610854   Unclassified

During a VLF experiment at Fairbanks, Alaska, an unusual chorus type of emission with a warbling or fluttering sound was heard on four different occasions. An example of the spectrum of the emission is presented which shows a series of bursts in the 1000- to 1800-cps range. Some of the bursts, which last for 1 to 3 sec, show a well-developed fine structure with several sharply rising tones at irregular spacing, each lasting about 0.1 sec. The emission bursts were associated with active periods in the aurora where groups of flashes or flickerings took place and, in the opinion of the observer, each of the short, sharply rising tones was associated with a flash in the aurora. Also presented is a band of hiss in the 600- to 1200 cps range.

2652

Stanford U. Stanford Electronics Labs., Calif.

DISCRETE VLF EMISSIONS FROM THE UPPER ATMOSPHERE, by N. Brice. Aug. 1964, 181p. (Technical rept. no. 3412-6; rept. no. SEL-64-088) (AFOSR-65-0070) (AF AFOSR-62-370) AD 610424   Unclassified

A new mechanism for the generation of emissions by energetic electrons—the transverse-resonance plasma instability--was found. The existence of this instability depends on the electron velocity component transverse to the earth's magnetic field rather than the component along the field. The emitted signals propagate along the field in a direction opposite to the drift of the electrons. This instability is nonconvective and, as such, has an inherent advantage over mechanisms previously suggested for explaining the generation of discrete emissions. The hypothesis that discrete VLF emissions are generated by this mechanism leads to a qualitative explanation of their diurnal variation, and much additional support for this hypothesis is found in the data.

2653

Stanford U. Stanford Electronics Labs., Calif.

FUNDAMENTALS OF VERY LOW FREQUENCY EMIS-

SION GENERATION MECHANISMS, by N. Brice. [1964] [8]p. (AFOSR-65-0262) (AF AFOSR-62-370) AD 611463   Unclassified

Also published in Jour. Geophys. Research, v. 69: 4515-4522, Nov. 1, 1964.

The transfer of energy between whistler-mode signals and energetic charged particles is examined. Resonance conditions are derived, leading to a classification of the mechanisms previously suggested for the generation of VLF emissions. The relationship between change in energy and change in pitch angle of the particles is derived for the transverse resonance interaction with longitudinal whistler-mode waves. Features of the transverse resonance plasma instabilities and the anomalous Doppler effect are clarified.

2654

Stanford U. [Stanford Electronics Labs.] Calif.

A QUALITATIVE EXPLANATION OF THE DIURNAL VARIATION OF CHORUS, by N. Brice. [1964] [3]p. (AFOSR-65-0263) (AF AFOSR-62-370) AD 611344   Unclassified

Also published in Jour. Geophys. Research, v. 69: 4701-4703, 1964.

It is suggested that the VLF emissions called chorus are generated by the transverse resonance plasma instability for electrons and that the production of this instability requires anisotropy in the electron velocity distribution. Phenomena which might give rise to the required anisotropy are considered. It is suggested that the compression of the outer magnetosphere by the solar wind would assist in producing the anisotropy. While no attempt is made to explain the systematic shift in the time of maximum chorus occurrence with latitude, it is shown that the compression of the magnetosphere leads to an explanation of the observation that chorus is generally observed between dawn and noon. A conservative estimate of the rate of increase in transverse energy of energetic electrons arising from this compression is found to be orders of magnitude greater than that required to explain the energies observed in chorus.

2655

Stanford U. [Stanford Electronics Labs.] Calif.

STUDIES OF PLANETARY ATMOSPHERES. I. THE DISTRIBUTION OF ELECTRONS AND IONS IN THE EARTH'S EXOSPHERE, by J. J. Angerami and J. O. Thomas. [1964] [24]p. (AFOSR-65-0364) (AF AFOSR-62-370) AD 612352   Unclassified

Also published in Jour. Geophys. Research, v. 69: 4537-4560, Nov. 1, 1964.

For abstract see item no. 2647.

2656

Stanford U. Stanford Electronics Labs., Calif.

A CIRCUIT AND NOISE MODEL OF THE FIELD-
EFFECT TRANSISTOR, by G. N. Bechtel, Jr. Apr.
1963 [83]p. incl. diagrs. tables, refs. (Technical
rept. no. 1612-1; rept. no. SEL-63-044) (AFOSR-
5000) (Nonr-22524) AD 407177   Unclassified

The field-effect transistor is treated from an active
R-C transmission-line approach, and a circuit model
is derived from a lumped-element approximation to
the line. The circuit model is found to be similar to
that often stated for the high-frequency (hf) circuit
model of the vacuum tube. The model is characterized
by the low-frequency (l-f) admittance parameters and
two high-frequency parameters: the cutoff frequency
(which is the frequency at which the hf transconductance
falls to one-half of its l-f value) and a constant relating
to the input conductance. A maximum useful frequency
for the device, which is close to the cutoff frequency,
is calculated from the model.

2657

Stanford U. [Stanford Electronics Labs.] Calif.

MEAN-SQUARE ERROR IN CORRELATION DEMODU-
LATORS, by B. F. Ludovici. [1963] 11p. (AFOSR-
64-0336) (Nonr-22524) AD 434512   Unclassified

Also published in Archiv. der Elektrischen
Übertragung, v. 17: 278-288, 1963.

Four different methods of extracting the intelligence
from an amplitude-modulated carrier in the presence
of noise are analyzed on a mean-square error basis.
Assumed is band-limited white gaussian noise and a
noise-like modulating intelligence of uniform power
spectrum ranging from dc to an upper limiting frequency
equal to two-thirds of the carrier frequency. Included
in the analysis are the square-law, autocorrelation,
two-amplifier and crosscorrelation demodulators. As
an important result, this investigation shows that the
autocorrelation demodulator offers no significant im-
provement over the simple square-law demodulator.

2658

Stanford U. Stanford Electronics Labs., Calif.

TIME-VARIANT COMMUNICATION CHANNELS, by
T. Kailath. Aug. 1963 [21]p. incl. diagrs. refs.
(Technical rept. no. 7050-1; rept. no. SEL-63-106)
(AFOSR-64-0346) (Nonr-22524) AD 420482
                                    Unclassified

Work on time-variant channels can be broken down
into five areas—methods of channel representation,
methods for measuring the instantaneous and average
behavior of the channel, the derivation of suitable
receiver structures for communication over such
channels, the evaluation of the performance of such
receivers, and studies of signal selection and coding
techniques to increase the speed and reliability of

communication. A fairly detailed summary of work
on the channel-characterization problem is presented.

2659

Stanford U. Stanford Electronics Labs., Calif.

MINIMUM-TIME CONTROL OF A LINEAR COMBINA-
TION OF STATE VARIABLES, by C. E. Hutchinson.
Aug. 1963 [86]p. incl. diagrs. refs. (Technical rept.
no. 6311-1; rept. no. SEL-63-071) (AFOSR-64-0351)
(Nonr-22524) AD 421525   Unclassified

This study is concerned with the problem of controlling
linear, time-invariant, one-input, one-output systems
with zeros of transmission at some (possibly complex)
frequencies. The available control effort is magnitude
limited, and there are no disturbances. Only the prob-
lem of eliminating initial conditions is considered. A
detailed analysis of second- and third-order systems
is made. The basic mathematical tool used in finding
the solution for the general problem is that of
Pontryagin's maximum principle.

2660

Stanford U. Stanford Electronics Labs., Calif.

A THIN-FILM, NICKEL OXIDE SWITCH, by W. E.
Beadle. Aug. 1963 [45]p. incl. illus. diagrs. tables.
(Technical rept. no. 4719-1; rept. no. SEL-63-075)
(AFOSR-64-0621) (Nonr-22524)   Unclassified

This report describes an electrically actuated, solid-
state switch. The switch is a two-terminal device
consisting of a thin nickel oxide film separating two
ohmic contacts. The gross properties of the switch are
(1) reversible switching between two impedance levels
(ON: 100 ohms; OFF: 25 megohms), and (2) electrical
actuation of the switch (turn-on: 500-v, 40-μ sec pulse;
turn-off: 300-ma, 10-nsec pulse). The fabrication of
the device from thermally grown nickel oxide is de-
scribed. A switching model for the device is established
on the basis of a series of experiments, and theoretical
calculations of switching times using this model are
made. Limited lifetimes observed for the device sug-
gest applications requiring single-shot operations
which utilize the insulating properties of the NiO film.
(Contractor's abstract)

2661

Stanford U. Stanford Electronics Labs., Calif.

LOOPS IN DIRECTED COMBINATIONAL SWITCHING
NETWORKS, by C. R. McCaw. Apr. 1963 [56]p. incl.
diagrs. tables, refs. (Technical rept. no. 6208-1;
rept. no. SEL-63-049) (AFOSR-64-0622) (Nonr-22524)
AD 417465   Unclassified

A loop in a network of directed elements is identified
as a closed path which traverses each element en-
countered in the direction from input to output. An
examination of such loops in networks of binary switching
gate elements reveals that some of them operate in a

combinational manner, yet others produce a sequential output. In networks of branch elements, sequential operation does not arise. Here the problem with loops arises in attempting to discover the form of the Boolean function expression which corresponds to the network. Three standard matrix forms are presented as tools for analyzing networks with loops. Synthesis techniques are presented to discover networks which require loops for minimality.

2662

Stanford U. Stanford Electronics Labs., Calif.

THRESHOLD CURRENT FOR P-N JUNCTION LASERS, by J. L. Moll and J. F. Gibbons. Apr. 1963 [15]p. (Technical rept. no. 1664-1; rept. no. SEL-63-013) (AFOSR-64-0623) (Nonr-22524) AD 404315
                                    Unclassified

In a recent letter, Lasher (IBM Jour., v. 7, Jan. 1963) gave the relation for threshold current in a p-n junction laser. In his calculation, Lasher neglected the effect of α_0 (absorption loss in the active region) on the threshold current because he felt that it was difficult to estimate. It is possible to include the absorptive effects associated with incomplete population inversion, and it is the purpose of this report to point out how this absorption should be included.

2663

Stanford U. Stanford Electronics Labs., Calif.

STATIC THEORY OF DENSITY AND POTENTIAL DISTRIBUTION IN A BEAM-GENERATED PLASMA, by D. A. Dunn and S. A. Self. July 1963 [36]p. incl. diagrs. table, refs. (Technical rept. no. 0311-1; rept. no. SEL-63-086) (AFOSR-64-0624) (Nonr-22524) AD 418683   Unclassified

An electron beam passing through a gas will ionize the gas; and the electrons and ions so produced will collect in the vicinity of the beam to form a plasma with a number density that can be much greater than the density of the beam. A one-dimensional static theory for such a system with a beam either partially or completely filling the space between two parallel planes that gives the plasma density and potential and potential distribution in the space is presented. The theory requires only minor modifications of the Langmuir-Tonks free-fall theory of the positive column. A plasma filling the space occupied by the beam is found to be separated by a low potential sheath from a somewhat lower density plasma extending to the walls where a second higher potential sheath is formed.

2664

Stanford U. Stanford Electronics Labs., Calif.

LAPLACE TRANSFORMS—DISTRIBUTIONAL THEORY, by R. W. Newcomb and R. G. Oliveira. June 1963 [99]p. incl. diagrs. refs. (Technical rept.

no. 2250-3; rept. no. SEL-63-021) (AFOSR-64-0625) (Nonr-22524) AD 413413   Unclassified

As Romans the gods of old Greece once revised,
So here we report in form generalized,
Transforms to whose name S. Laplace does apply,
Abstract at the time when L. Schwartz did espy.
The theory proceeds, distributions its start,
Come then the ideas Fourier at its heart.
By simple extension all properties come,
A multiplication included among.
(Contractor's abstract)

2665

Stanford U. Stanford Electronics Labs., Calif.

REPRODUCING DISTRIBUTIONS FOR MACHINE LEARNING, by J. D. Spragins, Jr. Nov. 1963 [113]p. incl. diagrs. tables, refs. (Technical rept. no. 6103-7; rept. no. SEL-63-099) (AFOSR-64-0695) (Nonr-22524) AD 431994   Unclassified

A model is proposed for learning the nature and value of an unknown parameter, or unknown parameters, in a probability distribution which forms part of a body of statistics related to some system or process. The model is Bayesian, involving the assumption of an a priori probability distribution over the possible values of the unknown parameters; the performance of experiments to gain information about the parameters; and the alteration of the a priori probabilities by Bayes' rule. In the limit, as the number of experiments approaches infinity, the a posteriori distribution in most cases encountered in practice approaches a delta function at the true values of the unknown parameters, so the system learns the values of the parameter exactly. The learning process developed in the paper is shown to be technically feasible if the a priori and a posteriori distributions are of the same form, with the learning accomplished by calculating new parameters for these distributions.

2666

Stanford U. Stanford Electronics Labs., Calif.

THE DESIGN OF WIDEBAND TRANSISTOR AMPLIFIERS BY AN EXTENSION OF THE SAMPLED-PARAMETER TECHNIQUE, by G. Danon and K. Sorenson. Nov. 1963 [47]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 4815-1; rept. no. SEL-63-121) (AFOSR-64-0901) (Nonr-22524) AD 434820
                                    Unclassified

The work presented here centers on the design of fast-pulse amplifiers by the sampled-parameter technique, in which the transistor is characterized by two-port parameters measured at a set of frequencies through the frequency band of interest. The feedback and coupling networks are selected by computations based on these sampled parameters. An application of this technique has led to an iterative stage using a 2N918 transistor, the characteristics of which are described.

2667

Stanford U. Stanford Electronics Labs., Calif.

SEEK-TIME IMPROVEMENT IN A RANDOM ACCESS
FILE BY APPLICATION OF AN ADAPTIVE ELEMENT,
by W. S. Buslik. Dec. 1963 [49]p. incl. diagrs.
(Technical rept. no. 6762-1; rept. no. SEL-63-135)
(AFOSR-64-0902) (Nonr-22524) AD 436020
Unclassified

An Adaline (adaptive linear neuron) can be trained to
distinguish between sets of inputs. In general, the
quantized output is used. This report investigates the
usefulness of the analog output of Adaline for measuring
the frequency of occurrence of a number of different
events. Each event is more or less arbitrarily associ-
ated with a pattern and it is shown that the degree to
which Adaline has been trained to recognize any one of
these patterns can be used as a measure of the frequency
of occurrence of the associated event. The application
of this use of Adaline to a random-access file is simu-
lated in order to show its use in reducing average access
time.

2668

Stanford U. Stanford Electronics Labs., Calif.

THE SYNTHESIS OF NONLINEAR FEEDBACK
REGISTERS, by K. B. Magleby. Oct. 1963 [95]p.
incl. diagrs. tables, refs. (Technical rept. no. 6207-
1; rept. no. SEL-63-118) (AFOSR-64-0903) (Nonr-
22524) AD 428081 Unclassified

Two domains that describe the behavior of a feedback
shift register were developed. These are the sequence
and polynomial domains, which are analogous to the
frequency and time domains in the description of
continuous systems. The domains are related by an
expansion of orthogonal functions. The synthesis
procedure developed in the polynomial domain consists
of four steps: (1) constructing a finite field with the
necessary properties; (2) finding the polynomials that
correspond to the desired output sequences; (3) obtain-
ing the polynomial that describes the shift register as
a product of the polynomials that represent the desired
output sequence; and (4) obtaining the feedback network
from the polynomial that describes the shift register.

2669

Stanford U. Stanford Electronics Labs., Calif.

CONTACTOR CONTROL BY ADAPTIVE PATTERN-
RECOGNITION TECHNIQUES, by F. W. Smith. Apr.
1964 [99]p. incl. illus. diagrs. tables, refs. (Tech-
nical rept. no. 6762-1; rept. no. SEL-64-042)
(AFOSR-64-1329) (Nonr-22524) AD 443083
Unclassified

The purpose of the research described herein is to
explore the possibility of utilizing pattern-recognition
techniques in the design of controllers for complex
dynamic processes. In this design reverse-time
trajectories are used to generate patterns that indicate

the position of the minimum-time optimal switching
surface. Adaptive pattern-recognition techniques are
used to find a readily implemented switching function
that closely approximates the optimal switching surface.
An adaptive threshold logic element—a trainable, linear,
pattern-recognition device—is used in conjunction with
other equipment to realize a trainable, nonlinear,
pattern-recognition device. The controller-design
procedure has been simplified by the ability of the
trainable function generator to generalize, i.e., to
learn the switching function for all regions of the
state space after being trained on patterns from only a
part of the space.

2670

Stanford U. Stanford Electronics Labs., Calif.

A FAST DIRECT SOLUTION OF POISSON'S EQUATION
USING FOURIER ANALYSIS, by R. W. Hockney. May
1964 [39]p. incl. diagrs. refs. (Technical rept. no.
0255-1; rept. no. SEL-64-056) (AFOSR-64-1330)
(Nonr-22524) AD 442209 Unclassified

The demand for rapid procedures to solve Poisson's
equation had lead to the development of a direct method
of solution involving Fourier analysis which can solve
Poisson's equation in a square region covered by a
48 x 48 mesh in 0.9 sec on the IBM 7090. This com-
pares favorably with the best iterative methods which
would require about 10 sec to solve the same problem.
The method is applicable to rectangular regions with
simple boundary conditions and the maximum observed
error in the potential for several random charge dis-
tributions is 5×10^{-7} of the maximum potential change
in the region. (Contractor's abstract)

2671

Stanford U. Stanford Electronics Labs., Calif.

CODING FOR ADAPTIVE CAPABILITY IN RANDOM-
CHANNEL COMBINATIONS, by R. A. Scholtz. Dec.
1963 [88]p. incl. diagrs. refs. (Technical rept. no.
6104-8; rept. no. SEL-63-124) (AFOSR-64-1331)
(Nonr-22524) AD 439820 Unclassified

The design of a random-channel communication system
is discussed. System performance is evaluated using
two different performance measures: divergence and
probability of error. The divergence measure is an
analytic tool for use with general channel statistics,
and is compared with a probability-of-error analysis
under more restricted statistical conditions. Optimum
relations are derived between channel statistics, re-
ceiver structure, signal encoding, and adaptive capa-
bility.

2672

Stanford U. Stanford Electronics Labs., Calif.

ORTHOGONAL EXPANSION APPLIED TO THE
DESIGN OF THRESHOLD-ELEMENT NETWORKS, by

J. A. Cooper. Dec. 1963 [105]p. incl. diagrs. tables, refs. (Technical rept. no. 6204-1; rept. no. SEL-63-123) (AFOSR-64-1332) (Nonr-22524) AD 436598
Unclassified

The design of switching functions using threshold logic units is discussed in this report. In an effort to gain insight into the problem of designing threshold-element networks and providing mathematical background for design procedures, a study of functions of linearly transformed (modulo-2) input variables is presented. Circuitry for realizing linearly decomposed functions consists of two parts: linear and nonlinear. The linear circuitry design is straightforward. Orthogonal expansion demonstrates that the nonlinear circuitry can always be realized by a single threshold element.

2673

Stanford U. Stanford Electronics Labs., Calif.

IDENTIFICATION AND CONTROL OF RANDOM-PARAMETER DISCRETE SYSTEMS, by J. B. Farison. Jan. 1964 [62]p. incl. diagrs. refs. (Technical rept. no. 6302-4; rept. no. SEL-64-008) (AFOSR-64-1334) (Nonr-22524) AD 440427 Unclassified

In the time-domain, state-space description of linear dynamic systems, the system is represented by the input and transition matrices, which determine how the control input and present state affect the next state. If one or more elements of the matrices are unknown or randomly varying parameters, the system is a random-parameter system. The present work is a study of discrete systems with random parameters that are correlated in time. The correlation of the random parameters permits parameter identification, or real-time learning of the random parameters, by processing the system output sequence.

2674

Stanford U. Stanford Electronics Labs., Calif.

OPTIMUM SAMPLING AND CONTROL PROCEDURES FOR A MULTIPLEXED DIGITAL COMPUTER, by E. J. Skiko. Mar. 1964 [90]p. incl. diagrs. refs. (Technical rept. no. 6302-5; rept. no. SEL-64-012) (AFOSR-64-1335) (Nonr-22524) AD 440428
Unclassified

The purpose of this research has been to derive the optimum sampling and control procedures for a multiple-ed digital computer. The mutiple-plant deterministic problem was solved in which the optimum control was derived, and it was shown that the optimum control schedule is explicitly determined by the pre-processing procedure. Finally, it was shown that the computation time required for the pre-processing procedure is rather large, although certainly acceptable under many situations. The modified, single-plant, deterministic case, wherein only one component of the control vector can be applied to the plant at each sampling instant, was solved. The optimum control was derived, and it was shown that the optimum control schedule is explicitly determined by the pre-processing procedure.

2675

Stanford U. Stanford Electronics Labs., Calif.

DYNAMIC PROGRAMMING WITH CONTINUOUS INDEPENDENT VARIABLE, by R. E. Larson. Apr. 1964 [105]p. incl. diagrs. refs. (Technical rept. no. 6302-6; rept. no. SEL-64-019) (AFOSR-64-1336) (Nonr-22524) AD 443041 Unclassified

In this study a computational procedure for solving optimal control problems, called dynamic programming with continuous independent variable, has been developed. This procedure has a high-speed memory requirement several orders of magnitude less than that of conventional dynamic programming, but it still retains the general applicability and other desirable features of the conventional method. In a typical example the reduction in high-speed memory requirement is from 10^6 to about 100 locations.

2676

Stanford U. Stanford Electronics Labs., Calif.

THE SYNTHESIS OF MACHINES WHICH LEARN WITHOUT A TEACHER, by S. C. Fralick. Apr. 1964 [23]p. incl. diagrs. (Technical rept. no. 6103-8; rept. no. SEL-64-028) (AFOSR-64-1337) (Nonr-22524) AD 443109 Unclassified

Techniques of decision theory are applied to the problem of learning to recognize patterns without a teacher. As a result a generalized a posteriori probability computer is obtained which includes the solution of the problem of learning without a teacher, learning with a teacher, and no learning. The resulting equations are shown to describe a system which may be synthesized in delay feedback form, of fixed size, which is stable and converges to that system which would be optimum if a priori knowledge was available so that no learning was required. The solution is used to synthesize three systems in black box form: (1) a general system which learns to make binary decisions, (2) a specific example of this system, and (3) a general system which learns to make multiple-category classifications.

2677

Stanford U. Stanford Electronics Labs., Calif.

CHARACTERISTICS OF PHOTON-COUPLED SYSTEMS, by I. Wunderman. Apr. 1964 [79]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 4814-1; rept. no. SEL-64-016) (AFOSR-64-1338) (Nonr-22524) AD 443189 Unclassified

When appropriately fabricated gallium arsenide diodes are biased in the forward direction, they emit a narrow band of radiation in the near infrared. With the current state of technology, it is feasible to incorporate these devices into active electronic amplifiers. This paper describes the properties and capabilities of circuits which can be made by mating these emitting sources to suitable photodetectors, forming 'photon-coupled pairs.' The unique characteristics of such configurations

are electrical isolation of input and output circuits, and unilateral signal transfer. Two specific application examples are discussed in detail.

2678

Stanford U. Stanford Electronics Labs., Calif.

OPTICAL ABSORPTION AND PHOTOLUMINESCENCE OF DOPED GaAs AND $(In_xGa_{1-x})As$, by C. M. Chang. Apr. 1964 [60]p. incl. diagrs. tables, refs. (Technical rept. no. 5064-2; rept. no. SEL-64-031) (AFOSR-64-1339) (Nonr-22524) AD 442491 Unclassified

Absorption coefficients near the fundamental absorption edge have been measured in P-type and N-type GaAs with various doping concentrations. With the aid of the principle of detail balance, these measurements were used to predict the spectra of spontaneous emissions under small excitations, and actual photoluminescence spectra were found to follow the predicted spectra closely. The photoluminescence spectra of Mn-doped GaAs at several different temperatures were studied. Indium was diffused into doped GaAs to modify the band-gap energy. The photoluminescence spectra and absorption coefficients of the diffused layers were measured. The photoluminescence of the diffused layer was found to be shifted in wavelength by an amount consistent with the indium surface concentration.

2679

Stanford U. Stanford Electronics Labs., Calif.

QUANTUM DESCRIPTIONS ON COMMUNICATION THEORY, by C.-Y. She. May 1964 [197]p. incl. diagrs. refs. (Technical rept. no. 0415-1; rept. no. SEL-64-074) (AFOSR-64-1577) (Nonr-22524) AD 443719 Unclassified

This work is an analytical investigation of the significance of quantum mechanical effects on the channel capacity of a communication system. One of the results of the work is the determination of the state of a quantum system after a simultaneous measurement of noncommuting observables is made with maximum accuracy allowed by the uncertainty principle of quantum mechanics. A second result arises when the theory of simultaneous measurement is applied to the communication system. It is found that each of the repeated measurements introduces one quantum of noise energy into the receiving cavity at the moment the measurement is performed. The noise at any one time is made up of the appropriately attenuated noise quanta introduced by each of the previous measurements.

2680

Stanford U. Stanford Electronics Labs., Calif.

IMPROVING THE RELIABILITY OF DIGITAL SYSTEMS BY REDUNDANCY AND RESTORING ORGANS, by J. K. Knox-Seith. Aug. 1964 [101]p. incl. diagrs.

tables, refs. (Technical rept. no. 4816-2; rept. no. SEL-64-094) (Nonr-22524) AD 449371

Unclassified

The use of redundant circuits and restoring organs as a technique for improving the reliability of digital systems has been evaluated, and guidelines for a near-optimum use of this technique in practical systems have been established. Two types of restoring organs, majority vote takers and simple adaptive vote takers, have been considered. A series of nomograms has been developed for determining the optimum trade-off between the number of redundant circuits and the number of vote takers to be used in any given situation, and for determining the resulting increase in system reliability. Several conventional measures of reliability have been considered; in addition the useful life T_Δ of a system has been defined as the longest mission time for which the system can operate with a probability of failure less than Δ, where Δ is usually much less than one.

2681

Stanford U. Stanford Electronics Labs., Calif.

PHOTOLUMINESCENCE IN GALLIUM PHOSPHIDE CRYSTALS, by B. P. F. Wu. July 1964 [64]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 5064-3; rept. no. SEL-64-086) (AFOSR-64-1905) (Nonr-22524) Unclassified

The results of this investigation indicate that: (1) The red photoluminescence centers may be created in GaP crystals by doping the nonluminous GaP with any one of the following elements: Zn, Te, Cd, Au, Cu, In, Al, Mn, S, Si, Se, and Mg. (2) The wavelength (or energy) and the intensity of the red photoluminescence peak created in GaP crystals are dependent on impurity-doping concentration. (3) No absorption band corresponding to the red photoluminescence peak was observed in luminous GaP crystals. (4) Heat treatment of GaP crystals in vacuum at temperatures above 700°C destroyed the red photoluminescence in GaP crystals.

2682

Stanford U. Stanford Electronics Labs., Calif.

QUANTUM EFFICIENCY AND RADIATIVE LIFETIME IN p-TYPE GaAs, by J. Vilms. Nov. 1964 [106]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 5207-1; rept. no. SEL-64-120) (AFOSR-65-0249) (Nonr-22524) AD 453727 Unclassified

A method to measure the quantum efficiency of radiative recombination in uniformly doped p-type gallium arsenide and to study the radiative lifetime has been developed. The method involves measurement of the efficiency (photon yield) of photoluminescence, separation of surface recombination from bulk recombination by varying the absorption length of the excitation light, measurement of electron-diffusion length by the spectral dependence of surface photovoltage and also by the absorption-length dependence of photoluminescence, and a theoretical estimate of the electron mobility.

2683

Stanford U. Stanford Electronics Labs., Calif.

THE SELECTION OF MEASUREMENTS FOR PREDIC-
TION, by D. C. Allais. Nov. 1964 [126]p. incl. diagrs.
tables, refs. (Technical rept. no. 6103-9; rept. no.
SEL-64-115) (AFOSR-65-0548) (Nonr-22524)
AD 456770   Unclassified

This research is concerned with prediction and pattern
recognition. The purpose is to study relationships
between a machine's performance and the number and
quality of its measurements and to devise techniques
of measurement selection and processing which yield
minimum error. The major emphasis is the prediction,
because it provides the more tractable model for
analysis. The primary effort is directed toward the
development of prediction or pattern-recognition
techniques applicable to problems involving relatively
many measurements and a limited number of learning
samples. Consideration of the normal prediction
model leads to particular methods of measurement
selection and processing.

2684

Stanford U. Stanford Electronics Labs., Calif.

THE BINARY CODING PROBLEM FOR A RANDOM
CHANNEL, by R. A. Scholtz. Jan. 1963, 28p. incl.
illus. refs. (Technical rept. no. 2004-7; rept. no.
SEL-63-002) (Nonr-22524) AD 299535
                                        Unclassified

The general optimum receiver is found for a class of
random channels through which a binary code is being
transmitted. Under certain simplifying assumptions
the divergence is calculated and used as a measure of
system performance. The divergence is then maximized
to yield a simple coding criterion involving a specifica-
tion of the optimum Hamming distance between code
words as a function of two channel parameters and the
code word length. Intuitive justification and interpreta-
tion are given after each optimization procedure has
been indicated mathematically.

2685

Stanford U. Stanford Electronics Labs., Calif.

AN EQUATORIAL TO ALTITUDE-AZIMUTH
COORDINATE CONVERTER, by E. F. Biondi. Mar.
1963, 34p. (Technical rept. no. 1306-2; rept. no.
SEL-63-028) (Nonr-22524) AD 441209
                                        Unclassified

This thesis develops a specialized digital computer
which converts equatorial coordinates into altitude-
azimuth coordinates. It briefly looks into three differ-
ent methods of computing altitude-azimuth coordinates.
One of these methods is considered best for the prac-
tical problem, that of obtaining coordinates for a large
radio telescope. A computer based on this chosen
method is then considered in detail.

2686

Stanford U. Stanford Electronics Labs., Calif.

THE FOUNDATIONS OF NETWORK THEORY, by R. W.
Newcomb. Mar. 1963, 46p. (Technical rept. no.
2250-4; rept. no. SEL-63-022) (Nonr-22524)
AD 406110   Unclassified

A basic theory of the most general types of conceivable
networks is presented. For this the author abandons
the operator concept, which is felt more appropriate
to control system studies, and reverts to the concept
of allowed pairs, whose origin can be traced to
McMillan. The program is to define a system, a net-
work, and an n-port in terms of infinitely differentiable
functions of support bounded on the left. The major
properties of such n-ports are then defined, such as
linearity, time-invariance, passivity and solvability.
Such physical networks are then extended to idealized
networks and more generalized variables through the
use of the theory of distributions. Once this is done,
general descriptions of a large class of linear, time-
invariant networks can be given by using exponential
variables. At this point the (bilateral) Laplace trans-
form approach can be used in the standard manner.

2687

Stanford U. Stanford Electronics Labs., Calif.

LEARNING THE MEAN VECTOR AND COVARIANCE
MATRIX OF GAUSSIAN SIGNALS IN PATTERN
RECOGNITION, by D. G. Keehn. Feb. 1963, 38p. incl.
illus. refs. (Technical rept. no. 2003-6; rept. no.
SEL-62-155) (Nonr-22524) AD 299526   Unclassified

This work presents a statistical approach to the prob-
lem of pattern recognition. The class of pattern-
recognition problems considered is completely general.
The pattern observations are viewed as vectors in a
signal space on which a gaussian probability law is de-
fined for each pattern class. The mean vectors and co-
variance matrices of these laws are taken as random
objects with known probability laws, and learning ob-
servations for each class are assumed. The optimum
classifier, the classifier which uses all the available
information to minimize the probability of misrecogni-
tion, is derived.

2688

Stanford U. Stanford Electronics Labs., Calif.

LOW-TEMPERATURE PROPERTIES OF GALLIUM
ARSENIDE DIODES, by D. J. Dumin. Sept. 1964, 77p.
(Technical rept. no. 5107-1; rept. no. SEL-64-097)
(Nonr-22524) AD 455160   Unclassified

The forward and reverse current-voltage characteris-
tics of zinc-diffused GaAs diodes were investigated
at temperatures between 300 and 4.2°K. This study
was initiated to explain the portions of the forward and
reverse currents that are nonthermal in origin. Zinc-
diffused GaAs diodes were produced and tested at tem-
peratures between 300 and 4.2°K. The low-temperature

forward current was explained in terms of a band-to-trap-to-band excess tunnelling model describable by two parameters: the effective tunnelling mass and the recombination probability. The reverse current was explained in terms of a band-to-band tunnelling model at all temperatures below 300°K.

2689

Stanford U. Stanford Electronics Labs., Calif.

NONLINEAR RESONANCE COMPUTER COMPONENTS, by T. Ozawa. Apr. 1963, 84p. (Technical rept. no. 1306-1; rept. no. SEL-63-034) (Nonr-22524) AD 441215 Unclassified

A mathematical analysis of the series resonant circuit is given. The principle of harmonic balance is applied to the differential equations for the circuit in order to obtain the steady state responses. It is shown that the circuit is a threshold device with respect to the amplitude of the driving voltage. A three phase clock system is used to drive the basic resonant circuits, which are coupled to form threshold logic. Various types of coupling between the circuits are considered. The transient response of the circuit which is closely related to the switching speed is analyzed by a series method.

2690

[Stanford U. Stanford Electronics Labs., Calif.]

OPTIMAL ADAPTIVE ESTIMATION OF SAMPLED STOCHASTIC PROCESSES, by D. T. Magill. May 1964, 78p. (Technical rept.) (Nonr-22524) AD 600600 Unclassified

This work presents an adaptive approach to the problem of estimating a sampled, scalar-valued, stochastic process described by an initially unknown parameter vector. Knowledge of this quantity completely specifies the statistics of the process, and consequently the optimal estimator must learn the value of the parameter vector. In order that construction of the optimal estimator be feasible it is necessary to consider only those processes whose parameter vector comes from a finite set of a priori known values. The optimal estimator is found to be composed of a set of elemental estimators and a corresponding set of weighting coefficients, one pair for each possible value of the parameter vector. This structure is derived using properties of the conditional mean operator. For gauss-markov processes the elemental estimators are linear, dynamic systems, and evaluation of the weighting coefficients involves relatively simple, nonlinear calculations.

2691

Stanford U. Stanford Electronics Labs., Calif.

PRACTICAL APPLICATIONS FOR ADAPTIVE DATA-PROCESSING SYSTEMS, by B. Widrow, R. J. Brown and others. June 13, 1964, 16p. (Nonr-22524) AD 451472 Unclassified

The paper summarizes the development and application of adaptive data-processing systems utilizing adaptive threshold elements. Several procedures are described whereby such systems can be adapted to recognize or classify complex digital and analog patterns. Data are presented showing application of adaptive pattern-recognition techniques to practical problems such as speech recognition, weather forecasting, and the diagnosis of heart disease as evidenced in vectorcardiograms. Several new applications are being studied, among which one of the most important is the detection of underwater sound signals.

2692

Stanford U. Stanford Electronics Labs., Calif.

SOME STATE-ASSIGNMENT TECHNIQUES FOR LARGE SEQUENTIAL CIRCUITS, by D. L. Starner. Aug. 1964, 54p. (Technical rept. no. 6203-1; rept. no. SEL-64-076) (Nonr-22524) AD 455645 Unclassified

Two state-assignment algorithms are developed, one of which has been programmed for a computer and will handle sequential machines as large as 128 states and 64 inputs. A flow table is used as the machine representation, and properties of the flow table are used to establish state-pair adjacency relationships. For these adjacency relationships a weighting procedure is presented which is used in determining the state codes. The set of state codes used in the algorithms is selected from those sets having some special properties which not only allow preselection of the codes but also reduce the enumeration required in the algorithms. In general, low-cost assignments were obtained without expending large amounts of time.

2693

Stanford U. Stanford Electronics Labs., Calif.

A THEORETICAL STUDY OF HOT ELECTRONS IN METAL FILMS, by C. A. Bates. Jan. 1963, 57p. (Technical rept. no. 216-1; rept. no. SEL-62-142) (Nonr-22524) AD 404829 Unclassified

An analysis of the motion of hot electrons when passing through a thin metal film is given, with particular reference to the cold-cathode emitter and photoelectric-type devices. Electron-electron collisions are considered to be responsible for the slowing down processes within the film and sufficient collisions are assumed to occur so that the motion is diffusive. The differential-scattering cross section is assumed to be almost spherically symmetrical in the center-of-mass system of coordinates, and thus the equations deduced by Wolff (which include electron multiplication) may be used. Methods of solving the integrodifferential equation are given.

2694

Stanford U. Stanford Electronics Labs., Calif.

TWO-LOOP GENERATOR FOR ONE-THIRD SUB-
HARMONICS, by Y. Kamp. Dec. 1964, 71p. (Techni-
cal rept. no. 6581-1; rept. no. SEL-64-128) (Nonr-
2.524) AD 457539   Unclassified

A one-third subharmonic generator, with a varactor as
coupling element between the two loops, is investig ted.
The necessary and sufficient conditions are established
for the building up of a subharmonic oscillation starting
from zero initial conditions. Subsequently, the analysis
is restricted to a cubic nonlinear characteristic. The
subharmonic steady state and its stability are discussed
in terms of the circuit parameters.

2695

Stanford U. Stanford Electronics Labs., Calif.

VECTORCARDIOGRAPHIC DIAGNOSIS UTILIZING
ADAPTIVE PATTERN-RECOGNITION TECHNIQUES,
by D. F. Specht. June 1964, 54p. (Technical rept.
no. 6753-1; rept. no. SEL-64-045) (Nonr-22524)
AD 443853   Unclassified

The purpose of this research was to apply adaptive
pattern-recognition techniques to the diagnosis of heart
disease as evidenced in vectorcardiograms. Two
methods by which adaptive pattern-recognition techniques
can be applied to the analysis of vectorcardiographic
data were developed and tested. The first method, the
polyhedron approach, considers tri-axial samples taken
from the vectorcardiogram at various times at separate
date points in three-dimensional space. The second
method, sequential adaptive processing, considers all
the time samples from a given record as a single point
in n-dimensional space. It was found that sequential
adaptive processing yields much better results than the
clinical analysis of electrocardiograms for detection
of abnormalities, with only a slight decrease in accu-
racy in the detection of normal waveforms.

2698

STD Research Corp., Pasadena, Calif.

INTERACTION OF A JET OF PLASMA WITH ELEC-
TRIC AND MAGNETIC FIELDS, by A. N. Kontaratos
and S. T. Demetriades. [1964] [26]p. incl. illus.
diagrs. tables, refs. (AFOSR-65-1418) (AF 49(638)-
1445)   Unclassified

Also published in Appl. Sci. Research, Sect. B, v. 11:
335-360 [1964].

A generalized ohm's law is used to predict changes in
the direction and magnitude of the momentum of a
stream of plasma in a crossed field accelerator in
terms of plasma properties and species temperatures
and concentrations. Measurements are reported of
accelerator thrust, plasma jet deflection angle, current-
voltage characteristics, accelerator inlet momentum,
cooling rates and cross-arc power input for argon and

helium plasmas. Estimates are given of the mean
values of some of the parameters of argon and helium
plasma obtained under nonequilibrium conditions.
These results are compared with other methods re-
quiring the assumption of local thermodynamic equilib-
rium (LTE).

2697

STD Research Corp., Pasadena, Calif.

ON THE FUNCTIONAL DEPENDENCE OF TOWNSEND'S
FIRST IONIZATION COEFFICIENT, by A. N.
Kontaratos. [1964] [8]p. (AFOSR-65-2503) (AF 49-
(638)1445) AD 627958   Unclassified

Also published in Appl. Sci. Research, Sect. B, v. 12:
27-32, 1964.

An expression is derived of Townsend's ionization
coefficient in terms of electric field and pressure,
which fits the experimental data for air in the range
$E/p = 10$ to 10^3 v/cm x mm Hg. (Contractor's abstract)

2698

STD Research Corp., Pasadena, Calif.

BREAKDOWN VOLTAGE CALCULATION FOR AIR IN
UNIFORM FIELDS, by A. N. Kontaratos. [1964] [9]p.
incl. diagrs. (AFOSR-65-2504) (AF 49(638)1445)
AD 628347   Unclassified

Also published in Appl. Sci. Research, Sect. B, v. 12:
18-26, 1964.

Expressions are derived for the determination of the
space-charge field in front of an avalanche, for the
widening of the avalanche's head due to electrostatic
repulsion and for the minimum breakdown voltage of
uniform gaps. In principle, this last condition is
based on a modification of the criterion for stream
advance developed by Raether, Meek et. al. An
attempt is made to consider the avalanche as an electric
dipole oriented in a direction parallel to the applied
field and use is made of the radial instead of the axial
field of the avalanche's head. (Contractor's abstract)

2699

Stevens Inst. of Tech., Hoboken, N. J.

ROTATIONAL EXCITATIONS AND TURBULENCE IN
LIQUID HELIUM, by L. Mead. May 1963, 26p. incl.
diagrs. table, refs. (Rept. no. R-982) (AFOSR-4877)
(AF AFOSR-82-125) AD 415463   Unclassified

The density of states function has been calculated from
specific heat measurements around the superfluid
transition temperature of liquid helium He^4. It exhibits
poles and branch points at integer multiples of K times
the transition temperature. The superfluid transition
exhibits some features in common with the Bardeen-
Cooper-Schrieffer and Kac-Uhlenbeck phase transition
theories. (Contractor's abstract)

2700

Stevens Inst. of Tech. [Dept. of Mathematics]
Hoboken, N. J.

THE ITALIAN CONTRIBUTION TO THE THEORY OF
NON-LINEAR ORDINARY DIFFERENTIAL EQUATIONS
AND TO NONLINEAR MECHANICS DURING THE
YEARS 1951-1961, by R. Conti, D. Graffi, and G.
Sansone. [1963] [26]p. (AFOSR-3745) (AF 49(638)-
878) AD 427859   Unclassified

Also published in Qualitative Methods in the Theory
of Nonlinear Vibrations; Proc. Internat'l. Symposium,
Kiev, (SSR), Izdat Akad. Nauk Ukrain., v. 2: 172-
180, 1963.

The report is limited to a short presentation of the
contribution made during the last decade by Italian
mathematicians, with two exceptions. The first refers
to the work made by Spanish mathematicians.

2701

Stevens Inst. of Tech. [Dept. of Mathematics]
Hoboken, N. J.

NON-LINEAR DIFFERENTIAL EQUATIONS, by G.
Sansone and R. Conti, tr. by A. H. Diamond. New
York, The MacMillan Co., 1964, 536p. incl. diagrs.
refs. (Internat'l. Ser. Monographs in Pure and
Applied Math., V. 67) (AFOSR-65-1197) (AF 49(638)-
878)   Unclassified

The book presents a detailed analysis of the phase
portrait of two-dimensional autonomous systems, a
survey of the qualitative methods for the discovery of
periodic solutions of periodic systems and a study
of asymptotic properties, especially stability proper-
ties, of the solutions of n-dimensional systems. An
extensive analysis is given of singular points of
two-dimensional autonomous systems, including
perturbed systems. The equations of Vander Pol and
Lienard of Oscillations of Relaxation are considered,
including questions of existence and uniqueness of
periodic solutions, and asymptotic evaluation of the
period. There is an extensive treatment of non-
autonomous systems with one degree of freedom.
Linear systems are described including the concepts
of principal fundamental matrix, characteristic ex-
ponents and type numbers. Asymptotic stability, uni-
form stability, orbital stability and asymptotic equi-
valence are also considered. (Contractor's abstract,
modified)

2702

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

MEASUREMENTS ON PLASMA VORTICES AND
TURBULENCE, by W. H. Bostick, E. Farber and
others. [1964] [12]p. incl. illus. diagrs. (AFOSR-65-
2133) (AF AFOSR-64-465) AD 629799 Unclassified

Also published in Internat'l. Symposium on Diffusion
of Plasma Across a Magnetic Field, Feldafing/
Starnberger (Germany) (June 29-July 3, 1964), p. 220-
231.

Plasma vortices are studies in three experimental
situations; (1) in plasma flow over a 3-dimensional
magnetic dipole, (2) in the plasma coaxial accelerator
with hydrogen gas employed, and (3) in firing a plasma
gun across a magnetic field. With respect to (1) it is
found that the turbulence spectrum for copper plasma
contains higher frequency components than that for
lithium. For (2) a series of three vortices is usually
observed following the current sheet. In nitrogen and
argon the vortices are smaller in diameter, more
numerous, and persist longer. In (3) the measured
decay of the velocity profile can be compared with the
calculated decay-by-diffusion. (Contractor's abstract,
modified)

2703

Stockholm U. [Dept. of Zoology] (Sweden).

LABORATORY OBSERVATIONS ON THE REPRODUC-
TIVE BEHAVIOUR OF THE PIGEON (COLUMBA
LIVIA) DURING THE PRE-INCUBATION PHASE OF
THE BREEDING CYCLE, by E. Fabricius and A.-M.
Jansson. [1963] [14]p. (AFOSR-64-1182) (AF 61-
(052)195) AD 442993   Unclassified
AD 442993
Also published in Animal Behav., v. 11: 534-547,
Oct. 1963.

The reproductive behavior of the pigeon has been de-
scribed. In the pigeon, much of the courtship behavior
occurs in the nest or at the nest site, which is usually
in a hidden place. To include these behavior patterns
in close observations of the breeding cycle, a number
of breeding couples in cages was studied. The observa-
tions reported here were designed to study the normal
sequence of the different actions, and the way they are
grouped together to form the behavior characteristic
of the preincubation period.

2704

Stockholm U. [Dept. of Zoology] (Sweden).

NEURAL MECHANISMS INVOLVED IN INSTINCTIVE
BEHAVIOR, by E. Fabricius. Final rept. Nov. 30,
1963, 1v. (AFOSR-64-0020) (AF EOAR-62-12)
AD 429768   Unclassified

Behavioral effects of radiolesions showed that while
intersection of the lateral forebrain bundle in the pigeon
causes severe disturbance of behavior, intersection of
the median forebrain bundle does not affect overt be-
havior. Fear responses persist after lesions sparing the
tractus occipito-mesencephalicus but intersecting other
parts of cerebral peduncles. Effects of telencephalic
radiolesions showed that restricted radiolesions in the
lateral forebrain bundle of the pigeon affect memory.
Transection of the tractus occipito-mesencephalicus in
a pigeon reduced fear responses. Phylogenetical
adaptation showed that in the beaver the ability of

constructing dams and lodges is mainly based on inborn stereotyped action patterns. The dam-building behavior is elicited by a particular type of acoustic stimulation. Full imprinting can only be established in the beaver before any fear responses are developed.

2705

Stockholm U. [Dept. of Zoology] (Sweden).

LONG RANGE NAVIGATION IN ANIMALS, by C. Edelstam. June 20, 1963, 14p. (AFOSR-J1106) (AF EOAR-62-108) AD 422919   Unclassified

A laboratory study of the basis of visual acuity in man suggests that vision may not be a limiting factor in astronavigation among vertebrates. Field observations of pigeons navigating without the aid of celestial clues show that the birds shake their heads sideways at intervals. This confirms a prediction made by Ising on the assumption that birds use their semicircular canals for estimating latitude and directions from Coriolis force differences.

2706

Stockholm U. [Inst. of Physics] (Sweden).

K^--ABSORPTION IN NUCLEI AND THE Σ HYPERON PION RESONANCE Y_0^*, by A. Frisk. 1964, 12p. (AFOSR-3130) (AF EOAR-62-15) AD 613700
Unclassified

The total energy distribution and the distribution of the invariant quantity M from 106 two prong stars are plotted with a charged Σ hyperon and a pion due to absorptions of negative K-mesons at rest in emulsion nuclei. It should be emphasized that the stars contain no other prongs than those due to the hyperon and the pion. The two distributions have about the same width and it is difficult to conclude anything about Y_0^* production on this basis.

2707

Stockholm U. Inst. of Physics (Sweden).

PION-ELECTRON SCATTERING AT 16 GEV/C, by J. Allan, G. Ekspon and others. [1964] [7]p. incl. diagrs. (AFOSR-64-2037) (AF EOAR-63-11) AD 452510   Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 1144-1150, June 1, 1964.

The pion-electron scattering cross-section as a function of the 4-momentum transfer has been measured using 16 gev/c negative pions incident on the CERN 30 cm hydrogen bubble chamber. The results are compared with theory. The overall agreement is good. A tendency, at high momentum transfers, toward lower experimental cross-sections than are expected from the theory for point-charge scattering has been

interpreted in terms of an extended pion. No definite conclusion on the pion size can be drawn other than that the radius is smaller than 4.5×10^{-15} m.

2708

Stockholm U. [Psychological Lab.] (Sweden).

PSYCHOPHYSICAL RELATIONS IN THE PERCEPTION OF VELOCITY, by M. Mashhour. Stockholm, Almqvist & Wiksell, 1964, 176p. incl. diagrs. tables, refs. (Acta Universitatis Stockholmiensis, Stockholm Studies in Psychology 3) (AFOSR-65-1303) (AF EOAR-64-29) AD 618289   Unclassified

An investigation is made into some observable aspects of man's reaction to visual stimulus moving at different speeds. General methodological problems and problems concerning motion and velocity perception proper are discussed. Topics treated are the two methods of measurement, magnitude and ratio estimation; power functions for biophysical data; the relationship between subjective velocity, space, and time; the relationship between man's speed of reaction and the velocity of the motion stimulus; and how information about velocity can be supplied to the higher centers. Evidence indicates that man's capability as a measuring instrument beyond the ordinal level is doubtful.

2709

Stockholm U. Psychological Lab. (Sweden).

AN EXPERIMENTAL STUDY ON RELATIVITY, ERROR AND SEX DIFFERENCES IN THE PERCEPTION OF VELOCITY, TIME AND DISTANCE, by M. Mashhour. Sept. 1963, 26p. incl. diagrs. tables, refs. (Rept. no. 159) (AFOSR-65-1305) (AF EOAR-64-29) AD 618133
Unclassified

Using the principle of relativity in perception, the effects are investigated of a moving stimulus involving time, space, and velocity with respect to response involving subjective time, space, and velocity. It was found that: (1) Subjective velocity of a moving object and subjective distance covered by a moving object are relative. (2) The absolute error of the subjective velocity estimates is a parabolic function of the subjective estimates of velocity lying between 0 - 1, while a linear function was found for values beyond 1. (3) Sex differences do not exist in the estimation of subjective time and space, though women have higher estimates of the same subjective speeds than do men. (Contractor's abstract, modified)

2710

Strasbourg U. Inst. de Recherches Nucleaires (France).

RADIATIVE CORRECTIONS IN THE ANGULAR CORRELATION OF MONOPOLE PAIRS FROM O^{16} AT SMALL ANGLES, by S. Gorodetzky, F. Scheibling and others. [1963] [5]p. incl. diagrs. table. (AFOSR-64-1753) (AF 61(052)598) AD 449253   Unclassified

Also published in Phys. Rev., v. 131: 1219-1223, Aug. 1, 1963.

The angular correlation of electron-positron pair emission in the $0^+ \to 0^+$ transition in O^{16} was investigated for very small angles. An enhancement of several percent in the emission rate at these small angles is expected, due to first-order radiative corrections represented principally by the vertex graph. The rapid rise in the correlation at small angles was experimentally verified, and the results are in agreement with the theory. (Contractor's abstract)

2711

Sussex U. Physics Lab., Brighton (Gt. Brit.).

SORPTION OF He^3 BETWEEN 0. 6°K AND 4. 2°K, by D. F. Brewer, A. J. Symonds, and A. L. Thomson. [1964] [3]p. incl. diagrs. (AFOSR-65-1339) (AF EOAR-64-13) AD 620717   Unclassified

Also published in Phys. Ltrs., v. 13: 298-300, Dec. 15, 1964.

The first step in determining the influence of surface effects on liquid He^3 is made by measuring the adsorption isotherms of He^3 on Vycor porous glass between 0. 625° and 4.2°K. A calculated error is used to measure the amount of He^3 adsorbed within approx 2×10^{-3} cm^3/m^2, with the exception of the 4.2°K isotherm. The quantity adsorbed is plotted against relative pressure for 3 representative temperatures below the critical temperature, and for 4.2°K.

2712

Sydney U. Dept. of Aeronautical Engineering (Australia).

APPROACH TO TRANSLATIONAL EQUILIBRIUM IN A RIGID SPHERE GAS, by G. A. Bird. [1963] [2]p. incl. diagrs. (AFOSR-64-0165) (AF AFOSR-63-299) AD 432559   Unclassified

Also published in Phys. Fluids, v. 6: 1518-1519, Oct. 1963.

It is usually assumed that the translational degree of freedom in a gas reaches equilibrium in a time of the order of the mean collision time. The present note reports on an investigation of this problem using a Monte Carlo type method which is valid for gases at normal and low densities, and is sufficiently economical in its computing requirements to enable information to be obtained on the velocity dependence of the rate of approach to equilibrium.

2713

Sydney U. Dept. of Aeronautical Engineering (Australia).

A GAS-DYNAMIC MODEL OF THE OUTER SOLAR ATMOSPHERE, by G. A. Bird. [1964] [6]p. incl. diagrs. refs. (AFOSR-64-2001) (AF AFOSR-63-299) AD 451703   Unclassified

Also published in Astrophys. Jour., v. 139: 684-688, Feb. 15, 1964.

Consideration is given to an atmosphere which is heated by the periodic passage of shock waves. A qualitative physical argument suggests that the atmosphere is likely to be in a state such that it has little effect on the strength of the shock waves. This constant shock-strength hypothesis is used as the basis of a model of the outer solar atmosphere, starting near the base of the chromosphere. The model correctly predicts the magnitude as well as the average gradient of the coronal temperature rise. Details are given of the resulting density and mass-flow distributions. (Contractor's abstract)

2714

Sydney U. Dept. of Aeronautical Engineering (Australia).

THE BEHAVIOR OF SHOCK WAVES IN A GRAVITATIONAL ATMOSPHERE, by G. A. Bird. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-64-2002) (AF AFOSR-63-299) AD 451702   Unclassified

Also published in Astrophys. Jour., v. 139: 675-683, Feb. 15, 1963.

The effects produced by the variations on properties of a gravitational atmosphere on a shock wave propagating within it are determined by an approximate analytical method. Expressions are presented for the rate of change of the shock strength with distance in plane, cylindrical and spherical atmospheres, with or without steady-mass motions, and with arbitrary distributions of temperature and composition. The special cases of the propagation of strong or weak shock waves in adiabatic or isothermal atmospheres are treated in some detail. (Contractor's abstract)

2715

Sydney U. Dept. of Aeronautical Engineering (Australia).

THE PROPAGATION OF ACOUSTIC WAVES THROUGH THE SOLAR CHROMOSPHERE, by G. A. Bird. [1964] [4]p. incl. diagr. table. (AFOSR-65-0559) (AF AFOSR-63-299) AD 613914   Unclassified

Also published in Astrophys. Jour., v. 140: 288-291, July 1, 1964.

Consideration is given to the acoustic disturbances produced by a piston oscillating with the frequency and amplitude of the photospheric granules. The method of characteristics is used to obtain numerical solutions of the full non-linear equations of motion. It is found that shock waves are formed within distances of the order of 1000 km. These shock waves are expected to propagate through the chromosphere with their strengths virtually unaffected by the atmosphere. It is concluded that the results of linearized theory must be treated with caution. (Contractor's abstract)

2716

Sydney U. School of Physics (Australia).

APPLICATIONS OF CHEBYSHEV SERIES IN
NUMERICAL ANALYSIS, by D. Elliott. Final rept.
July 1, 1962-Aug. 17, 1963, 1v. incl. diagrs. tables,
refs. (AFOSR-J1261) (AF AFOSR-62-397)
AD 424352   Unclassified

Numerical solutions of integral equations by means of
Chebyshev series are presented in five reports. These
are: A Chebyshev series method for the numerical
solution of Fredholm integral equations; Some comments
on a paper by Clenshaw and Norton (analytical investiga-
tion of the iterative method in the numerical solution
of simple problems); The evaluation and estimation
of the coefficients in the Chebyshev series expansion of
a function; The numerical evaluation of the polynomial
of best fit of a differential function; Truncation errors
in certain polynomial approximations; A note on the
coefficients in the Chebyshev series expansion of a func-
tion.

2717

[Sydney U. School of Physics (Australia)]

A CHEBYSHEV SERIES METHOD FOR THE
NUMERICAL SOLUTION OF FREDHOLM INTEGRAL
EQUATIONS, by D. Elliott. [1963] [10]p. incl. tables,
refs. (AFOSR-J1278) (AF AFOSR-62-397)
                                       Unclassified

Also published in Comput. Jour., v. 6: 102-111, Apr.
1963.

An investigation has been made into the solution of
non-linear Fredholm integral equation by means of
determining directly the coefficients in the Chebyshev
series expansion of the unknown function. An error
analysis, valid under fairly restrictive conditions, is
included together with two worked examples. (Con-
tractor's abstract)

2718

Sydney U. School of Physics (Australia).

THE MESON MULTIPLICITY IN NUCLEON-NUCLEON
COLLISIONS AT 3000 GEV, by C. B. A. McCusker
and L. S. Peak. [1964] [16]p. incl. diagrs. tables,
refs. (AFOSR-65-1809) (AF AFOSR-62-410)
AD 625767   Unclassified

Also published in Nuovo Cimento, Series X, v. 31:
525-540, Feb. 1, 1964.

The mean multiplicity of charged particles in nucleon-
nucleon collisions at 2800 gev is determined by two
different methods. The two methods give results in
good agreement with each other and with Wilson cloud
chamber results. The weighted mean from this ex-
periment is $<n_s> = 10.8 \pm 0.8$. The mean energy has
been found by two different methods, the second of
which involves a determination of the cosmic-ray
proton energy spectrum from 10^{10} to 10^{16} ev. The
change in the average multiplicity in nucleon-nucleon
collisions from 16 gev to 2800 gev can be well approx-
imated by a law $<n_s> = 4.1 \log E/10g 16$ where E is the
incident proton energy in gev. (Contractor's abstract)

2719

Sydney U. [School of Physics] (Australia).

A PRELIMINARY MEASUREMENT OF THE ANGULAR
DIAMETER OF ALPHA-LYRAE, by R. H. Brown, C.
Hazard and others. [1964] [2]p. (AFOSR-64-1979)
(AF AFOSR-63-302) AD 452360   Unclassified

Also published in Nature, v. 201: 1111-1112, Mar. 14,
1964.

During the final assembly of the new interferometer
a series of observations was carried out on the bright
star alpha-Lyrae (Vega) with the primary purpose of
testing the general performance of the instrument.
These observations showed the instrument to be per-
forming satisfactorily although the signal-to-noise ratio
was only about a half of that which should be achieved
on completion of the alignment of the optical and elec-
tronic channels. The results of the observations on
Vega represent the first direct measurement of a star
of spectral type as early as A0. The interferometer is
described.

2720

Sydney U. School of Physics (Australia).

THE STELLAR INTERFEROMETER AT NARRABRI
OBSERVATORY, by R. H. Brown. [1964] [6]p. incl.
illus. diagrs. (AFOSR-65-0406) (AF AFOSR-63-302)
AD 612518   Unclassified

Also published in Sky and Telescope, v. 28: 2-7,
Aug. 1964.

This note describes the stellar intensity interferometer
at Narrabri Observatory in Australia, designed to
measure the apparent angular sizes and temperatures
of stars. It is an improvement of the Mickelson inter-
ferometer with its need for high mechanical precision,
its problem of atmospheric scintillation, and its
somewhat subjective judgement and skill.

2721

Sydney U. [School of Physics] (Australia).

THE STELLAR INTERFEROMETER AT NARRABRI,
by R. H. Brown. 1964, 3p. (AFOSR-65-0450)
(AF AFOSR-63-302) AD 614536   Unclassified

Presented at Internat'l. Commission for Optics Conf.
on Interference and Coherence, Sydney (Australia),
Aug. 24-27, 1964.

The interferometer at Narrabri makes use of an
intensity interferometer to achieve a max resolution of
approx 0.0005 sec of arc. It is designed to measure

the apparent angular diameter of all stars brighter than magnitude +2.5 and with spectral type earlier than F. O. The instrument consists of 2 large mirrors 22 ft in diameter which move on a circular track 618 ft in diameter. The mirrors are controlled by a computer to follow the chosen star in azimuth and elevation. A single observation at 1 spacing requires approximately 3 hr for a star of magnitude +1.0.

2722

Sydney U. School of Physics (Australia).

THE DETAILED STRUCTURE OF AIR SHOWER CORES, by A. D. Bray, D. F. Crawford and others. [1964] [20]p. incl. illus. diagrs. tables, refs. (AFOSR-64-2060) (AF AFOSR-63-305) AD 452469
Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 827-846, May 16, 1964.

An array of 64 large plastic scintillators, 5 Wilson cloud chambers and about 500 G-M counters has been used to study the electronic structure of air-shower cores. It has been found that there is no unique structure function that will describe all cores. Cores can be classed as single, multiple or flat-topped. Multiple-cored and flat-topped showers can be simulated by the summation of a number of spatially separated single cores. It is shown that the multiply cored showers cannot be due to cascades produced by the neutral pions from a single interaction but that the core structure is due to the nature of the primary particle. The central density of single-cored showers of a given total size is considerably higher on average than the central density of multiply cored showers of the same size. (Contractor's abstract, modified)

2723

Sydney U. School of Physics (Australia).

ENERGY ESTIMATION FOR HIGH-ENERGY NUCLEAR INTERACTIONS, by L. S. Peak and R. L. S. Woolcott. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-1811) (AF AFOSR-63-305) AD 625564 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1-10, Oct. 1, 1964.

The inaccuracies of the various energy estimators for high-energy nuclear collisions are discussed. A new method of estimation based on a two-center model is proposed, involving measurement of the quartile angle, δ, and catering for multiple collisons. With this model $T\delta$, where T is the energy of the created particles, is shown to be dependent upon the fireball multiplicity and values of $T\delta$ are shown to be consistent with the model and a nucleon-nucleon charged multiplicity of ≈ 10. The method is shown to estimate primary energies more in accordance with the cosmic-ray energy spectrum than the Castagnoli method and is further verified by comparison with machine energies. (Contractor's abstract)

2724

Syracuse U. Dept. of Chemistry, N. Y.

MAGNETIC PROPERTIES OF ZIRCONIUM (III) AND HAFNIUM (III) IODIDES, by W. A. Baker, Jr. and A. R. Janus. [1964] [11]p. incl. diagrs. table, refs. (AFOSR-65-0799) (AF AFOSR-62-215) AD 616211
Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 2087-2097, 1964.

Zirconium triiodide and hafnium triiodide were prepared by aluminum reductions of the corresponding tetrahalides. Green and black species of both compounds were isolated. The magnetic susceptibilities of these compounds were measured over the temperature range 100°-300°K by the Gouy method. A correlation of observed magnetic and structural properties is given in terms of competing ferromagnetic and antiferromagnetic interactions in the lattice. The visible absorption spectrum was measured for species obtained on dissolution of zirconium triiodide in water. Absorption bands were assigned for what is proposed to be the hexaquozirconium ion and a less stable iodinated species of the aquozirconium ion. (Contractor's abstract)

2725

Syracuse U. [Dept. of Mathematics] N. Y.

PROBLEMS OF MEROMORPHIC FUNCTIONS, by A. Edrei. Final rept. July 1, 1959-June 30, 1963, 3p. (AFOSR-J1536) (AF 49(638)571) AD 427526
Unclassified

For a four-year period, the field of meromorphic functions was researched. Stress was placed on the study of Nevanlinna's theory, particularly the notion of 'deficient value.' Bibliographic data are included of papers written on this topic.

2726

Syracuse U. [Dept. of Mathematics] N. Y.

THE DEFICIENCIES OF MEROMORPHIC FUNCTIONS OF FINITE LOWER ORDER, by A. Edrei. [1964] [21]p. (AFOSR-65-0349) (AF 49(638)571) AD 611914
Unclassified

Also published in Duke Math. Jour., v. 31: 1-21, Mar. 1964.

This paper generalizes to functions of lower order μ several results which were previously known for functions of order μ only. It has considerable overlap with the independent work of I. V. Ostrovskii.

2727

Syracuse U. [Dept. of Mathematics] N. Y.

SOME GEOMETRIC ASPECTS OF FUNCTIONS OF

HARDY CLASS H^p, by G. T. Cargo. [1963] [4]p.
(AFOSR-65-0866) (AF 49(638)571) AD 617208
Unclassified

Also published in Jour. Math. Anal. and Appl., v. 7:
471-474, Dec. 1963.

This note discusses the geometric character of functions
of the Hardy Class H^p. It is proved that a holomorphic
function in D which omits a half-line is in H^p if $0 <
p < 1/2$, and more generally that a function whose
range is contained in a wedge of angular measure α
is in H^p if $0 < p < \pi/\alpha$. These results are extensions
of Smirnoff's classical theorem concerning functions
with positive real parts and, as it is shown, are con-
sequences of Littlewood's subordination principle.
A brief description of some related results is given,
and a new proof of Prawitz's inequality is sketched.

2728

[Syracuse U. Dept. of Mathematics, N. Y.]

ENTROPIES OF SEVERAL SETS OF REAL VALUED
FUNCTIONS, by G. F. Clements. [1963] [11]p.
(AFOSR-64-0714) (AF 49(638)619) AD 436494
Unclassified

Also published in Pacific Jour. Math., v. 13: 1085-
1095, 1963.

In this paper the entropies of several sets of real
valued functions are calculated. The entropy of a
metric set, is a measure of its size in terms of the
minimal number of sets of diameter not exceeding 2E
necessary to cover it. The most striking use of this
notion shows that not all functions of n variables can
be represented by functions of fewer variables if only
functions satisfying certain smoothness conditions
are allowed.

2729

Syracuse U. [Dept. of Mathematics] N. Y

STRONG AND ORDINARY SUMMABILITY, by G. G.
Lorentz and K. Zeller. [1963] [7]p. (AFOSR-64-
0715) (AF AFOSR-62-138) AD 436487
Unclassified

Also published in Tohoku Math. Jour., v. 15: 315-
321, Dec. 1963.

A discussion is presented of infinite matrices and
corresponding matrix transforms and summability
methods. A sequence is said to be summable, if all
sums exist and converge. The sequence is strongly
summable, if all sums exist and converge to zero.
Strong summability is usually considered only for
positive matrices. In this case the limit is uniquely
determined. A row-finite matrix contains only a
finite number of non-zero elements in each row; a
normal matrix has non-zero elements on the main
diagonal and zeros above it. Strong and ordinary sum-
mability methods are compared.

2730

Syracuse U. Dept. of Mathematics, N. Y.

[COORDINATE SUMMABILITY AND A THEOREM OF
HARDY-BOHR] Abschnittslimitierbarkeit und der
Satz von Hardy-Bohr, by G. G. Lorentz and K. Zeller.
[1964] [6]p. (AFOSR-64-1719) (AF AFOSR-62-138)
AD 447700 Unclassified

Also published in Arch. Math., v. 15: 208-213, 1964.

Working from the theory of Cesaro summability and
using a sequence f_k, which, under given conditions is
called a C_p-series - factor sequence the theory of
Hardy-Bohr is proven, explained, and expanded. This
method of proof is advantageous in that the general
factors f_k are only introduced at the end of the proof.
Before introducing these, other special easily handled
and finite sequences of binomial coefficients are used.
Using the described procedure asymptotic summability
can also be treated. Most important to the method pre-
sented is the proof of coordinate summability.

2731

Syracuse U. [Dept. of Mathematics] N. Y.

SUMMATION OF SEQUENCES AND SUMMATION OF
SERIES, by G. G. Lorentz and K. Zeller. [1964]
[4]p. (AFOSR-65-0321) (AF AFOSR-62-138)
AD 611920 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15:
743-746, Oct. 1964.

In this paper it is shown that there exist regular sequence
summation methods for which the summability field
is not contained in the summability field of any regular
series summation method. On the other hand there are
regular series methods for which the summability field
is not contained in the summability field of any regular
sequence summation method.

2732

Syracuse U. Dept. of Mathematics, N. Y.

ENTROPY AND ITS APPLICATIONS, by G. G. Lorentz.
[1964] [7]p. incl. diagr. (AFOSR-65-0332) (AF
AFOSR-63-424) AD 611919 Unclassified

Also published in SIAM Jour. Numer. Anal., Series B,
v. 1: 97-103, 1964.

ne concept of metric entropy is explained. For a
compact metric space A, the metric entropy was de-
vised to describe the massivity, the thickness of A.
The entropy of A, $H_\epsilon(A) = \log N_\epsilon(A)$ where $N_\epsilon(A)$ is the
minimum number of subsets forming an ϵ-cover of A.
A companion invariant of A is the capacity $C_\epsilon(A) =
\log M(\epsilon)$ where $M(\epsilon)$ is the maximum number of ϵ-dis-
tinguishable points of A. Some examples of entropy
are presented, and some applications are considered

for Vitushkin's work on nonlinear approximation and Kolmogorov's representation theorem for continuous functions of two variables. The entropy of A is compared with the properties of A which are important in the theory of approximation.

2733

Syracuse U. [Dept. of Physics] N. Y.

THEORETICAL STUDIES OF VIBRATION SPECTRA AND EFFECTS OF SURFACES ON LATTICE VIBRA- TIONS. Final rept. July 1963, 10p. (AFOSR-J1115) (AF 49(638)642) AD 420329   Unclassified

Effort was devoted to understanding the lattice vibra- tion spectra of simple, mixed, ionic covalent com- pounds. Simple compounds crystallizing in the sphaler- ite and, more recently, in the wurtzite structures were considered. Some problems were studied on the effects of impurities and imperfections on solid state systems. A start was made in the field of ferromag- netism to understand the magnetic structure of $MnBr_2$.

2734

Syracuse U. [Dept. of Physics] N. Y.

MULTIPHONON PROCESSES IN THE PHOTOCON- DUCTIVITY OF InSb, by H. J. Stocker, C. R. Stannard, Jr. and others. [1964] [4]p. (AFOSR-64- 1245) (AF 49(638)642) AD 442818   Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 163-166, Feb. 17, 1964.

Oscillations periodic in longitudinal optical (LO) phonon energy have been observed in the photoconductivity spectrum of acceptor-valence band transitions in Cu-, Au-, and Ag-doped InSb and in Cu- and Zn-doped Ge. Similar oscillations are found in the photoconductivity due to valence-conduction band transitions in p-type InSb doped with Au, Ag, and Cu. The spacing of the oscillations is characteristic of both the LO phonon energy and the band structure of InSb. A more in- volved interpretation than previously given has to be adopted to account for the lack of oscillatory struc- ture in the optical absorption.

2735

[Syracuse U. Dept. of Physics, N. Y.]

QUANTUM FIELD THEORY AND ELEMENTARY PARTICLES, by A. O. Barut. Final rept. Jan. 1, 1960-Aug. 31, 1962, 5p. incl. refs. (AFOSR-3539) (AF 49(638)801) AD 285426   Unclassified

The nature of the research carried on under this contract can be summarized under the following re- sults: (1) The S matrix theory has been formulated in an invariant fashion which made it possible to treat scattering of particles with arbitrary spins and iso- spins and their analytical continuation uniformly; (2) The recent hypothesis about the complex angular

momentum poles of the relativistic S matrix has been investigated and properties of these poles determined. Complex angular momentum has been extended to the scattering of particles with arbitrary spins; and (3) The two components higher order spinor equations have been quantized for the first time predicting 'neutrinos' for each fermian. Other research includes the investigation of strange particles and hyperfragments and work on electrodynamics and weak interactions.

2736

Syracuse U. Dept. of Physics, N. Y.

LATTICE VIBRATIONS OF WURTZITE STRUCTURE CRYSTALS, by J. J. Sullivan. [1964] [18]p. incl. diagrs. tables, refs. (AFOSR-66-1267) (AF AFOSR- 63-420) AD 641539   Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 1039-1056, 1964.

This article presents expressions based on the general shell model of lattice dynamics, for all important long wavelength properties of the lattice vibration spectrum of a wurtzite structure crystal and for the vibration frequencies having wave vectors along the hexagonal axis of the first Brillouin zone. The dynamics of the wurtzite structure is discussed in terms of sum and difference mode parameters. In an effort to evaluate some of the parameters of the model by fitting theoretical expres- sions to available experimental data, two approximations have been made: (1) The non-Coulomb force constants are limited to interactions with the four nearest neighbors. (2) The dynamics of the sum modes is made equivalent to the dynamics of a sphalerite crystal. (Contractor's abstract, modified)

2737

Syracuse U. Dept. of Physics, N. Y.

APPROACHES TO PIEZOELECTRICITY AND ELAS- TICITY IN MIXED IONIC COVALENT COMPOUNDS, by H. Kaplan. [1964] [10]p. incl. tables, refs. (AFOSR-66-1614) (AF AFOSR-63-420) AD 641538
Unclassified

Also published in Lattice Dynamics; Proc. Internat'l. Conf., Copenhagen (Denmark) (Aug. 5-9, 1963), Oxford, Pergamon Press, 1964, p. 615-624.

The problems of calculating the elastic and piezoelectric responses of mixed ionic covalent compounds are reviewed using the sphalerite and wurtzite structures as examples. Most of the discussion centers around the piezoelectric constant. The various lattice dynamical models of piezoelectricity in sphalerite are discussed in detail. The roles of piezoelectricity and elasticity as two facets of lattice dynamics are emphasized. It is concluded that the presently available experimental data on lattice dynamical properties and the lattice dynamics analysis does not allow unique values of important parameters such as the ionic charge to be determined. (Contrac- tor's abstract, modified)

2738

System Development Corp., Santa Monica, Calif.

ON ASSESSING THE EFFECTIVENESS OF ADMIN-
ISTERING PRIORITIES IN INFORMATION SYSTEMS,
by B. Rome and S. Rome. 1963, 46p. (AFOSR-
J527) (AF 49(638)1188) AD 408407   Unclassified

Also published in Proc. Military Operations Research
Symposia (Oct. 16-18, 1962), v. 2, Part 1: 31-46.

The problem is that of assessing the effectiveness of
command or executive decisions in administering
priorities within a large information system. Effective
administration of priorities dominates the flow and
sequence of productive operations, the organization
of communication and decision processes, and there-
fore the very survival of the organization. A simple
index or measure of the resolving power (the ability
to process higher priority units in shorter times) of a
set of decision rules for assigning and implementing
priorities is described. It will be employed in the
data-reduction programs of the Leviathan program
system.

2739

System Development Corp. [Santa Monica, Calif.].

PROGRAMMING THE BUREAUCRATIC COMPUTER,
by B. Rome and S. Rome. [1964] [21]p. incl. diagrs.
tables. (AFOSR-65-0295) (AF 49(638)1188)
AD 611810   Unclassified

Also published in IEEE Spectrum, Dec. 1964, p. 72-
92.

A system of logic in communications is evolved for
the hierarchy echelons of large corporations, and
wherein the digital computer plays vital parts—from
executing the command decisions of the C-in-C to
the robotlike obedience of a rear-rank private.
Through this method individuals are moulded into
effective, coherent social organisms.

2740

System Development Corp., Santa Monica, Calif.

COMMUNICATION AND LARGE ORGANIZATIONS,
by B. Rome and S. Rome. Sept. 4, 1964, 108p. incl.
illus. diagrs. tables. (Technical rept. no. SP-
1690/000/00) (AFOSR-65-0699) (AF 49(638)1188)
AD 608587   Unclassified

Presented at AFOSR summer Scient. Seminar on
Commun. Cybernetics, Cloudcroft, N. M., June 17-
18, 1964.

This note is comprised of 2 related reports; one is an
explanation of the Leviathan method for studying com-
munication in large social organizations and the other
is a review of some of the results obtained in experi-
mentations with this method. The method comprises
a theoretical framework, a system of computer

programs, a series of experimental simulations in a
laboratory, a repertory of experimental controls, and
quantitative measurements of organizational perform-
ance. The concept of hierarchy in large social organiza-
tions is stressed and the experimental model consists
of a bureaucracy of robots from the computer programs
and live personnel. Feedback from the computer sys-
tem is given special attention and the General Operator-
Computer Interaction system is introduced. Results
indicate the success of this type of investigation.

2741

System Development Corp., Santa Monica, Calif.

DATA FURNISHED SUBJECTS DURING LEVIATHAN
LIVE-ARTIFICIAL EXPERIMENTS, by B. Rome and
S. Rome. Mar. 15, 1963, 23p. incl. table. (Rept. no.
TM-1010/000/01) (AFOSR-65-0700) (AF 49(638)1188)
AD 403449   Unclassified

This document specifies the data which will be
supplied to the live subjects during the Leviathan live-
artificial experiments and describes how it is admin-
istered to them by the system. Each subject will re-
ceive an individual set of data every epoch. Precisely
which data he receives are defined by his status in the
hierarchy of command, the territory in the productive
system over which he exercises control, and the par-
ticular functions for which he is administratively re-
sponsible. For any specific configuration of the formal
organization specified to the computer and exhibited by
the management hierarchy, the computer automatically
produces the appropriate data for each live subject.

2742

System Development Corp., Santa Monica, Calif.

RESTATEMENT OF THE LEVIATHAN APPROACH TO
LARGE-GROUP ANALYSIS, by B. Rome and S. Rome.
July 22, 1963, 6p. incl. refs. (Rept. no. TM-1410/
000)00) (AFOSR-65-0701) (AF 49(638)1188)
AD 416804   Unclassified

This report is a summary of the Leviathan approach
to the study of the organization and management of
large information systems. The problem investigated
is the shift and development of interaction in a large
information organization under rapidly increasing load.
The Leviathan studies aim to translate such a situation
into orderly laboratory operations and into complex
abstract computer models. The resultant Leviathan
simulation consists of live responsible executives or
officers, hundreds of artificial agents, realized in the
computer; and systems for time-ordered input, inter-
action, an artificial laboratory language, and computer
produced feedback information. A distinct advantage
of the method is that it is able to explore the conse-
quences of a developing situation in 2 directions, one
actually taken, the other contrary to fact.

2743

System Development Corp., Santa Monica, Calif.

INPUT SPECIFICATIONS FOR LEVIATHAN RUN 301, by B. Rome and S. Rome. June 28, 1963, 24p. incl. tables. (Rept. no. TM-1346) (AFOSR-65-0702) (AF 49(638)1188) AD 410872   Unclassified

This report contains the experimenters' input specifications for initiating the Leviathan laboratory operations r in 301, which began May 16, 1963.

2744

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: FIFTH BRIEFING, by B. Rome and S. Rome. June 5, 1964, 71p (Rept. no. TM-1923/005/00) (AFOSR-65-0703) (AF 49(638)-1188) AD 446812   Unclassified

This report contains the data presented during the fifth briefing on manpower for the Intelligence Communications Control Center.

2745

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: FOURTH BRIEFING, by B. Rome and S. Rome. June 5, 1964, 55p. (Rept. no., TM-1923/004/00) (AFOSR-65-0704) (AF 49(638)1188) AD 446797   Unclassified

This report contains the data presented during the fourth briefing on traffic control and priority control for the Intelligence Communications Control Center.

2746

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: THIRD BRIEFING, by B. Rome and S. Rome. June 5, 1964, 42p. (Rept. no. TM-1923/003/00) (AFOSR-65-0705) (AF 49(638)-1188) AD 443758   Unclassified

This report contains the data presented during the third briefing covering code tags and traffic over A-1 and B stations for the Intelligence Communications Control Center.

2747

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: SECOND BRIEFING, by B. Rome and S. Rome. June 5, 1964, 37p. (Rept. no. TM-1923/002/00) (AFOSR-65-0706) (AF 49(638)1188) AD 446810   Unclassified

This report contains the data presented during the second briefing on technological system layout, alloca-

tion of territory, and production control of the Intelligence Communications Control Center.

2748

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: FIRST BRIEFING, by B. Rome and S. Rome. June 5, 1964, 14p. (Rept. no. TM-1923/001/00) (AFOSR-65-0707) (AF 49(638)1188) AD 446807   Unclassified

The Leviathan teaching machine was used, as part of the experimental design, to indoctrinate subjects for the Leviathan experiments of 1964. The machine consists of five briefings. At each briefing the first display, which presents the title and contents of the briefing, is controlled by the experimenters, and thereafter each subject controls the sequence and timing of his successive instructional displays. This report contains the data presented during the first briefing on the mission, organization, and management of the Intelligence Communications Control Center.

2749

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: MANUAL OF CHARTS, by B. Rome and S. Rome. June 5, 1964, 17p. incl. diagrs. tables. (Rept. no. TM-1923/000/00) (AFOSR-65-0708) (AF 49(638)1188) AD 446805   Unclassified

The Leviathan teaching machine was used, as part of the experimental design, to indoctrinate subjects for the Leviathan experiments of 1964. This report contains diagrams and tables displaying preliminary organization for the machine.

2750

System Research, Ltd., Richmond, Surrey (Gt. Brit.).

A TYPICAL ADAPTIVELY CONTROLLED EXPERIMENT IN PERCEPTUAL DISCRIMINATION, by G. Pask, B. N. Lewis, and D. Watts. Nov. 1964, 9p. (AFOSR-65-0291) (AF 61(052)640) AD 611542   Unclassified

This report concerns a demonstration of an adaptively controlled perceptual discrimination experiment. The adaptation rule chosen for demonstration purposes is almost absurdly simple and a rather more elaborate system is used in the main experimental programme. The chief aim is to provide a readily manipulable application of this experimental method and to suggest further applications. This method has been used chiefly in connection with explicit learning experiments or in adaptively controlled teaching. In the present arrangement the learning that occurs is implicit and, in a sense, is an unwanted effect. The adaptive system can be said to compensate for the effects of learning and to approximate a stationary measurement condition.

2751

System Research, Ltd., Richmond, Surrey (Gt. Brit.).

RESEARCH ON CYBERNETIC INVESTIGATION OF
LEARNING AND PERCEPTION, by G. Pask. Dec. 8,
1964 [176]p. incl. diagrs. tables, refs. (Annual sum-
mary rept. no. 2) (AFOSR-65-0292) (AF 61(052)640)
AD 611543   Unclassified

A number of cybernetic models for learning and mem-
ory are discussed. Certain experiments for testing
these models are described and some results are pre-
sented. The report contains a philosophical discussion,
an account of tests for macroscopic hypotheses, a de-
scription of evolutionary programs simulating learning
mechanisms and of algorithmic programs used to simu-
late sequential descriptions of the learning process.

2752

System Research, Ltd., Richmond, Surrey (Gt. Brit.).

A DISCUSSION OF ARTIFICIAL INTELLIGENCE AND
SELF-ORGANIZATION, by G. Pask. [1964] [116]p.
incl. diagrs. refs. (AFOSR-65-1168) (AF 61(052)640)
AD 620496   Unclassified

Also published in Advances in Computers, ed. by F. L.
Alt and M. Rubinoff. New York, Academic Press,
v. 5: 110-225, 1964.

The characteristics of a self-organizing system, a
system with a behavior that becomes more ordered,
is outlined. A special case is developed for self-
organization as it appears in connection with automata
or computing machines. Discussion is centered on
learning and on mechanisms that give rise to learning
behavior. Various psychological and physiological
models of human learning and concept acquisition are
examined. Man-machine interaction is considered—man
educates the machine and the machine extends man's
capabilities. It is concluded that an artificial intelligence
is more economically created by allowing it to evolve
to the environment it will later inhabit providing that we
ensure its survival by building into it a set of basic and
necessary capabilities.

2753

[Tasmania U. Dept. of Mathematics, Hobart (Australia)]

THE EVALUATION AND ESTIMATION OF THE COEF-
FICIENTS IN THE CHEBYSHEV SERIES EXPANSION
OF A FUNCTION, by D. Elliott. [1964] [11]p. inci.
refs. (AFOSR-64-1735) (AF AFOSR-64-600)
AD 448275   Unclassified

Also published in Math. Comput., v. 18: 274-284,
Apr. 1964.

This paper has considered estimates for the coefficients
in the Chebyshev series expansion of a function $f(x)$.
The form of the estimate depends upon whether $f(z)$ has
poles, or has a branch point on the real axis including
the cnd points $z = \pm 1$, or whether $f(x)$ is an entire func-
tion. The results may be superposed.

2754

Technical Operations, Inc., Washington, D. C.

AUTOVALOR DOCUMENT SERIES. VOL. III. AIR
OPERATIONS MODEL, PROGRAM SPECIFICATIONS
MANUAL, by H. Weintrob, S. Cohen and others. July
1964, 409p. (Rept. no. TR-64-2, v. 3) (AF 49(638)-
1179) AD 457521   Unclassified

This document contains a description and explanation
of the computer program used in the AUTOVALOR Air
Operations Model. The generation, sort, assessment,
damage reporting and updating functions are described.
Each routine is fully explained by its functional descrip-
tion, inputs, outputs, algorithms, and flow chart. The
interrelations between routines and between functions
are completely detailed.

2755

Technical Operations, Inc., Washington, D. C.

AUTOVALOR DOCUMENT SERIES. VOL. IV. LO-
GISTICS MODEL, PROGRAM SPECIFICATIONS MANU-
AL, by E. D. Steele, H. M. Ferguson, and E. M.
Ambrose, Jr. July 1964, 215p. (Rept. no. TR-64-
2, v. 4) (AF 49(638)1179) AD 457522   Unclassified

This paper describes in detail the logical processes
performed by each routine in the AUTOVALOR Lo-
gistics Model program. This model simulates the day
by day operations of a Theater logistics system for all
major supply categories. Process and routine descrip-
tions, flow charts, as well as input and output descrip-
tions, are provided for each of the five major functions
of the model.

2756

Technical Operations, Inc., Washington, D. C.

AUTOVALOR DOCUMENT SERIES. VOL. II. SYSTEM
OPERATOR'S MANUAL, by S. Cohen, R. A. Lajoie

and others. July 1964, 118p. (Rept. no. TR-64-2,
v. 2) (AF 49(638)1179) AD 457520   Unclassified

This manual contains specific instructions to the AUTO-
VALOR user on what he must do to make the system
perform its programmed tasks. It is divided into two
parts: one explains to the user how to prepare the data
he has compiled for presentation to the computer, and
one explains what the computer operater must do to
cause the program to operate properly.

2757

Technical Operations, Inc., Washington, D. C.

AUTOVALOR DOCUMENT SERIES. VOL. I. WAR
GAMERS' GUIDE, by R. W. Bluehdorn, S. Cohen and
others. July 1964, 1v. (Rept. no. TR-64-2, v. 1)
(AF 49(638)1179) AD 457519   Unclassified

The AUTOVALOR series contains five documents which
completely describe the three models in the AUTOVALOR
System. This volume explains to the war gamer, how
to organize input data, how to submit orders, and what
to expect as output. A General Description section is
included for each model followed by a Detailed Descrip-
tion of the data base requirements plus illustrations
for each input format. Requirements for player imple-
mentation are followed by descriptions of outputs and
some analysis aspects.

2758

Technical Operations, Inc., Washington, D. C.

PRELIMINARY ANALYSIS OF STRIKE RECONNAIS-
SANCE, by F. F. Martin. Apr. 1964, 72p. (Rept. no.
SM-64-4) (AF 49(638)1179) AD 457518
                                         Unclassified

Search concepts are investigated and analyzed with
respect to strike reconnaissance. Search theory, meth-
ods, and techniques are discussed. Reconnaissance
operations and basic sequence of events are given. Sta-
tistical parameters are discussed, and a mathematical
mode of strike reconnaissance is developed.

2759

Technical Operations, Inc., Washington, D. C.

STAGE OUTPUT PROCESSOR USERS AND OPERATORS
MANUAL ADDENDUM, by N. U. Kaminsky, L. G.
Klopfenstein and others. Mar. 1964, 123p. (Rept. no.
TR-63-2-2) (AF 49(638)1179) AD 451492
                                         Unclassified

The STAGE Output Processor sorts, compiles tables,
and presents the output of the STAGE model in printed
form. Fifteen new processes have been added to the
model since the publication of the STAGE Output Proc-
essor Users and Operators Manual in August 1963.
These 15 are discussed here and the output tables they
produce are described. Modifications and improvements
in the concepts used in the Output Processor are

included, along with a description of items that have
been modified or added to the existing output tables.
In some cases a table has been changed sufficiently to
warrant inclusion of a revised table.

2760

Technical Operations, Inc., Washington, D. C.

STAGE SIMULATOR TECHNICAL MANUAL. SECTION
4A. FLOW CHARTS FOR AREA REFUEL MODEL.
June 1964, 25p. (Rept. no. TR-61-2-1, Sec. 4A)
(AF 49(638)1179) AD 451493   Unclassified

The Area Refuel Model handles the simulation of bomber
and tanker refueling operations. This publication con-
tains gross and detailed flow charts, describing the
overall simulation.

2761

Technical Operations, Inc., Washington, D. C.

STAGE SIMULATOR TECHNICAL MANUAL. SECTION
6A. FLOW CHARTS FOR BASE THREAT MODEL, by
A. K. Anderson and C. Rossow. June 1964, 7p. (Rept.
no. TR-61-2-1, Sec. 6A) (AF 49(638)1179) AD 451489
                                    Unclassified

The Base Threat Model handles the simulation of sorties
that are in a position to threaten bases. This publica-
tion contains gross and detailed flow charts that de-
scribe the operation.

2762

Technical Operations, Inc., Washington, D. C.

STAGE SIMULATOR TECHNICAL MANUAL. SECTION
7A. FLOW CHARTS FOR INDEPENDENT ACTIONS
MODEL. May 1964, 43p. (Rept. no. TR-61-2-1, Sec.
7A) (AF 49(638)1179) AD 451491   Unclassified

The Independent Actions Model of the STAGE Simulator
handles the simulation of sortie actions that are site-
independent. This publication contains both gross and
detailed flow charts for each type of site-independent
simulation.

2763

Technical Operations, Inc., Washington, D. C.

STAGE SIMULATOR TECHNICAL MANUAL. SECTION
5A. FLOW CHARTS FOR OFFENSIVE BASE ACTIVI-
TIES MODEL. June 1964, 1v. (Rept. no. TR-61-2-1,
Sec. 5A) (AF 49(638)1179) AD 451490   Unclassified

The activities referred to in this publication pertain to
the operations of tankers and bombers at offensive
bases. Gross and detailed flow charts describe these
operations, which consist of takeoffs, evacuation, land-
ings, and a type of land-in area.

2764

Technical Research Group, Inc., Melville, N. Y.

FREQUENCY STABILIZATION OF GAS LASERS, by
W. R. Bennett, Jr., S. F. Jacobs and others. [1964]
[2]p. incl. refs. (AFOSR-65-2795) (AF 49(638)673)
AD 629156   Unclassified

Presented at Northeast Electronics Research and Engi-
neering Meeting, Nov. 4-6, 1964.

Also published in NEREM Record, 1964.

This paper summarizes analyses of several possible
gas laser stabilization techniques and reviews results
obtained recently with a null-balance method proposed
previously by one of the authors.

2765

Technical Research Group, Inc., Melville, N. Y.

STRONG 3.27-μ LASER OSCILLATION IN XENON, by
W. T. Walter and S. M. Jarrett. [1964] [2]p. incl.
diagr. table. (AFOSR-65-2610) (AF 49(638)673)
AD 629161   Unclassified

Also published in Appl. Opt., v. 3: 789-790, June 1964.

This letter describes some studies of stimulated emis-
sion of a pure xenon discharge contained in a quartz
tube with quartz Brewster angle windows and external
reflectors.

2766

Technical Research Group, Inc., Melville, N. Y.

ON THE THEORY OF LASER OSCILLATION, by S. R.
Barone. [1964] [1]p. (AFOSR-65-2617) (AF 49(638)-
673) AD 627967   Unclassified

Also published in Conf. on Quantum Electrodynamics
of High Intensity Photon Beams, U. S. Army Research
Office, Durham, N. C., Aug. 26-27, 1964.

Conventional theories of laser oscillation neglect the ef-
fect of the oscillating field on the atomic response func-
tion except in so far as this field determines the atomic
populations. Here an attempt has been made to go be-
yond this by considering the atomic response function
to be determined in self-consistent fashion by the os-
cillating field. The model chosen for calculation con-
sists of two-level atoms and a single (lossy) cavity
mode. Retaining only the lowest order correlations be-
tween the two-level systems and the field, new effects
appear for large values of the oscillating spectral energy
density.

2767

Technical Research Group, Inc., Melville, N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES, ed.

by R. Kaplan. Quarterly technical summary rept. no. 9, June 1-Aug. 31, 1964, 48p. (Rept. no. 134-QTR-9) (AF 49(638)673; AD 447907   Unclassified

This report discusses research on laser devices in two major areas: gas laser media and output control. An apparatus was completed for testing the principle of relaxation of the lower laser level in a gas discharge by inelastic atom-atom collisions. Progress was made in the investigation of improvements in energy radiance which can be achieved by mode selection in a ruby cavity. An accurate technique for measuring pulse energy per unit solid angle was established. A five-fold increase in angular energy density was observed when one reflector was moved far enough away from the ruby to discriminate effectively against off-axis modes.

2768

Technion-Israel Inst. of Tech., Haifa.

TACTICAL CONFIGURATIONS. ON COVERING OF BALANCED INCOMPLETE BLOCK DESIGNS, by H. Hanani. Feb. 20, 1964, 17p. (AFOSR-64-0868A) (Bound with its AFOSR-64-0868B) (AF EOAR-63-60)   Unclassified

Also published in Canad. Jour. Math., v. 16: 615-625, 1964. (AFOSR-65-0356; AD 612223)

It is proved that for every v there exists a balanced incomplete block design of v elements and of blocks having three elements each, and a set of F having $f(3, \lambda, v)$ elements such that F has non empty inter-section with every block of the design and $f(3, \lambda, v) = 1/2(v-1)$, $1/2(v + 1)$ or $1/2v$.

2769

Technion-Israel Inst. of Tech., Haifa.

TACTICAL CONFIGURATIONS. ON STEINER SYSTEMS, by H. Hanani and J. Schonheim. Feb. 20, 1964, 5p. (AFOSR-64-0868B) (Bound with its AFOSR-64-0868A) (AF EOAR-63-60)   Unclassified

It is proved that for every set E having $n = 2^{k-1}-1$ elements, Steiner k-tuple system exists.

2770

Technion-Israel Inst. of Tech., Haifa.

APPLICATION OF TERNARY ALGEBRA TO THE STUDY OF STATIC HAZARDS, by M. Yoeli and S. Rinon. [1964] [14]p. incl. diagrs. tables, refs. (AFOSR-64-0652) (AF EOAR-63-65) AD 436516   Unclassified

Also published in Jour. Assoc. Comput. Mach., v. 11: 84-97, Jan. 1964.

This paper is concerned with the study of static hazards in combinational switching circuits by means of

a suitable ternary switching algebra. Techniques for hazard detection and elimination are developed which are analogous to the Huffman-McCluskey procedures. Moreover, the paper derives necessary and sufficient conditions for a ternary function to adequately describe the steady-state and static hazard behavior of a combinational network. The sufficiency of these conditions is proved constructively leading to a method for the synthesis of combinational network containing static hazards as specified.

2771

Technion-Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

RECENT EXPERIMENTAL STUDIES OF BUCKLING OF CONICAL SHELLS UNDER TORSION AND EXTERNAL PRESSURE, by J. Singer and A. Eckstein. [1963] [12]p. (AFOSR-J850) (AF 61(052)339) AD 416382   Unclassified

Also published in Proc. Fifth Israel Conf. on Aviation and Astronautics, Feb. 27-28, 1963, p. 135-146.

The results of a continuation of an experimental program on the instability of thin truncated conical shells under uniform external pressure, under torsion, and under the combined loading of external pressure and torsion are presented and discussed. The tests of 58 Alclad, stainless steel and aluminum alloy conical shells of varying geometries are described, and the results are compared and correlated with other experimental investigations and with theory.

2772

Technion-Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

DONNELL-TYPE EQUATIONS FOR BENDING AND BUCKLING OF ORTHOTROPIC CONICAL SHELLS, by J. Singer. [1963] [3]p. (TAE rept. no. 18) (AFOSR-64-1028) (AF 61(052)339) AD 440982   Unclassified

Also published in Jour. Appl. Mech., June 1963, p. 303-305.

A set of Donnell-type differential equations for the bending and buckling of isotropic thin conical shells is derived for orthotropic conical shells. The equations derived reduce to Seide's equations for the case of an isotropic shell, and to the differential equations for orthotropic cylindrical shells given by Bodner when the cone angle approaches zero.

2773

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

AERODYNAMICS OF SUPERSONIC WINGS AND BODIES OSCILLATING AT HIGH FREQUENCY, by M.

Hania. [Final rept.] Jan. 31, 1963, 42p. incl. refs.
(TAE rept. no. 26) (AFOSR-4861) (AF 61(052)550)
AD 413761   Unclassified

Asymptotic solutions are obtained for the unsteady pres-
sure on wings and bodies that oscillate harmonically at
high frequencies while in supersonic flight. The solu-
tions have the form of series in descending powers of
the frequency, and they include effects of three-dimen-
sional flow and second-order effects due to the thick-
ness of the wing or the body. The results consist of
(a) the first two terms of the series for three-dimen-
sional wings with supersonic trailing edges and for
elongated pointed bodies, (b) the first three terms of
the series for supersonic two-dimensional airfoils, and
(c) the first four terms for very slender wings and bod-
ies. (Contractor's abstract, modified)

2774

Technion-Israel Inst. of Tech. Dept. of Aeronautical
Engineering, Haifa.

EFFECT OF ECCENTRICITY OF STIFFENERS ON
THE GENERAL INSTABILITY OF STIFFENED CYLIN-
DRICAL SHELLS UNDER HYDROSTATIC PRESSURE,
by M. Baruch and J. Singer. [1963] [5]p. incl. diagr.
table. (AFOSR-J719) (AF EOAR-62-61)
                                             Unclassified

Also published in Jour. Mech. Eng. Sci., v. 5: 23-27,
1963.

The general instability of a simply supported cylindrical
shell under hydrostatic pressure is analysed by consid-
ering the 'distributed stiffness' of the frames and
stringers separately, taking into account their eccen-
tricity. It is shown that frames on the inside of the
shell yield general instability loads about 10-15%
greater than frames on the outside of the shell.
Stringers are much less effective in stiffening a shell
under hydrostatic pressure, and the effect of eccentrici-
ty is opposite; outside stringers yield critical loads
greater than inside stringers. (Contractor's abstract)

2775

Technion-Israel Inst. of Tech. [Dept. of Aeronautical
Engineering] Haifa.

BUCKLING OF ISOTROPIC, ORTHOTROPIC AND
RING-STIFFENED CONICAL SHELLS, by J. Singer,
A. Eckstein and others. Sept. 1963, 65p. (TAE rept.
no. 30) (AF EOAR-62-61) AD 434845   Unclassified

Results of a continuation of an experimental program
on the general and panel instability of thin ring-stif-
fened conical shells under uniform external pressure
are presented and discussed. Tests of ten steel and
aluminum-alloy conical shells are described; the re-
sults compare favorably with previously developed
theories. A method developed previously is now ex-
tended to the analysis of the instability of isotropic

conical shells under combined torsion and axial com-
pression, and of orthotropic conical shells under com-
bined torsion and external or internal pressure, or
axial force.

2776

Technion-Israel Inst. of Tech. [Dept. of Aeronautical
Engineering] Haifa.

BUCKLING OF ORTHOTROPIC CONICAL SHELLS UN-
DER COMBINED TORSION AND EXTERNAL OR IN-
TERNAL PRESSURE, by J. Singer, R. Fersht-Scher,
and A. Betser. [1964] [11]p. incl. diagrs. tables.
(AFOSR-64-1874) (AF EOAR-62-61) AD 449994
                                             Unclassified

Also published in Sixth Annual Conf. on Aviation and
Astronautics, Tel Aviv and Haifa (Israel) (Feb. 24-
25, 1964), p. 179-189.

A method developed previously for the analysis of buck-
ling of orthotropic conical shells under external pres-
sure is now extended to buckling under combined tor-
sion and external or internal pressure. The method is
based on the solution of modified Donnell type stability
equations in the presence of slightly relaxed boundary
conditions for the u and v displacements. Numerical
results are obtained for buckling under pure torsion and
a simple approximate method for calculation of the crit-
ical torque is found by correlation with equivalent ortho-
tropic cylindrical shells. (Contractor's abstract)

2777

Technion-Israel Inst. of Tech. Dept. of Aeronautical
Engineering, Haifa.

ON EXPERIMENTAL TECHNIQUE FOR INTERACTION
CURVES OF BUCKLING OF SHELLS, by J. Singer.
[1964] [2]p. incl. diagrs. (AFOSR-65-1150) (AF EOAR-
62-61) AD 619635   Unclassified

Also published in Exper. Mech., Sept. 1964, p. 1-2.

Experimentally determined points for interaction curves
of buckling of shells under combined torsion and ex-
ternal pressure often show excessive scatter. Scatter
mainly results from minor differences among shells.
Testing of single specimens over the whole range of
the curve is recommended even for metal specimens,
because the scatter produced by damage due to repeat-
ed buckling is much less than that resulting from the ini-
tial difference in shape and properties of separate
specimens.

2778

Technion-Israel Inst. of Tech. [Dept. of Aeronautical
Engineering] Haifa.

GENERAL INSTABILITY OF STIFFENED CIRCULAR
CONICAL SHELLS UNDER HYDROSTATIC PRESSURE,

by M. Baruch and J. Singer. June 1963, 64p. (Rept. no. TN-2; TAE rept. no. 26) (AFOSR-5321) (AF EOAR-63-56) AD 419706   Unclassified

Donnell type equilibrium and stability equations are derived for stiffened thin conical shells. The force - and moment - strain relations of the combined stiffener-sheet cross-section are determined by the assumption of identical normal strains at the contact surface of stiffener and sheet. The stability equations are solved for general instability under hydrostatic pressure by the method of virtual displacements. The solution proposed for stiffened conical shells involves the concepts of "correcting coefficients" and minimization of corresponding "error loads". Typical examples are analyzed and the effect of eccentricity of stiffeners is investigated. Simplified approximate formulae for the critical pressure of frame-stiffened conical shells are also proposed.

2779

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

EQUILIBRIUM AND STABILITY EQUATIONS FOR STIFFENED SHELLS, by M. Baruch. [1964] [6]p. incl. diagrs. (AFOSR-64-2000) (AF EOAR-63-58) AD 451167
AD 451167   Unclassified

Also published in Sixth Annual Conf. on Aviation and Astronautics, Tel Aviv, and Haifa (Israel) (Feb. 24-25, 1964), p. 117-124.

The usual approach to the analysis of a stiffened shell is to replace it by an equivalent orthotropic shell. Such an approach, however, does not take into account the eccentricity of stiffeners, and requires a constant orthogonal behavior of the shell. The proposed approach is based on the following assumptions concerning stiffeners. (1) The stiffeners are distributed over the whole surface of the shell. (2) The normal strains in the stiffener and in the sheet are equal at their point of contact.

2760

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

AERODYNAMIC FORCES ON SUPERSONIC AIRFOILS OSCILLATING AT HIGH FREQUENCY INCLUDING SECOND-ORDER THICKNESS EFFECTS, by M. Hanin. [1963] [6]p. (AFOSR-J1029) (AF EOAR-63-66)
AD 416296   Unclassified

Also published in Fifth Annual Conf. on Aviation and Astronautics, Tel Aviv and Haifa (Israel) (Feb. 27-28, 1963), p. 94-99.

A solution is obtained for the pressure on two-dimensional airfoils that oscillate harmonically at high frequencies while in supersonic flight. The solution has the form of an asymptotic series in descending powers of the frequency, and its coefficients include nonlinear effects of airfoil thickness to the second-order. In the derivation, the oscillatory part of the flow is regarded

as a perturbation super-imposed on the steady isentropic simple-wave flow past the airfoil in mean position. The asymptotic solution is deduced from the differential equation and boundary conditions of the oscillatory flow by applying a method of eikonal representation.

2781

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

APPLICATIONS OF A HIGH-FREQUENCY AERODYNAMIC THEORY TO THE CALCULATION OF FLUTTER AT SUPERSONIC SPEEDS, by M. Hanin and E. Nissim. Final rept. Dec. 1964 [50]p. incl. diagrs. refs. (TAE rept. no. 36) (AFOSR-65-1008) (AF EOAR-63-66) AD 617931   Unclassified

Flutter of airfoil sections in bending, torsion, and control-surface rotation at supersonic flight speeds is analyzed by employing an aerodynamic solution for high-frequency oscillations. The analysis includes effects of airfoil thickness and shape, and is valid at arbitrary supersonic Mach numbers and sufficiently high values of frequency variable. For flutter problems with 2 degrees of freedom, such as bending-torsion, bending-aileron, and torsion-aileron, explicit expressions for calculating the flutter speed and frequency are obtained. The case of 3 degrees of freedom, bending-torsion-aileron flutter, is studied by solving the determinant equation numerically. Some calculated results are presented, showing the variation of flutter boundaries with the elastic and inertial properties of the airfoil, the flight conditions and the airfoil thickness. (Contractor's abstract)

2782

Technion-Israel Inst. of Tech. [Dept. of Mechanics] Haifa.

THE PHYSICAL TENSOR AND APPLICATIONS, by Z. Karni. Jan. 7, 1963, 27p. (AFOSR-4960) (AF EOAR-62-57) AD 413337   Unclassified

The definition of the physical tensor and tensor field, the transformation laws for its magnitudes with respect to orthogonal and oblique systems, the directional derivative of a tensor, the curvilinear derivative of the tensor magnitudes and the Christoffel tensor in orthogonal systems, the plane finite rotation tensor and the physical curvature tensor are reported. As applications, the transforming of a Cartesian tensor equation to curvilinear coordinates, a multi-relative motion with respect to curvilinear networks and the merging of the Lagrange equations of motion and the geodesics equation into a single physical tensor equation of the Newton type are discussed.

2783

Technion-Israel Inst. of Tech. [Dept. of Mechanics] Haifa.

PHYSICAL TENSORS AND TENSOR FIELDS, by Z.

Karni. [1963] [4]p. (AFOSR-J708) (AF EOAR-62-57)
AD 413677   Unclassified

Also published in Fifth Annual Conf. on Aviation and
Astronautics, Tel Aviv and Haifa, (Israel) (Feb. 27-
28, 1963), p. 147-150.

A definition of the physical tensor is presented, from
which the transformation laws for its magnitudes with
respect to oblique systems of reference are derived.

2764

Technion-Israel Inst. of Tech. Dept. of Mechanics,
Haifa.

THE PHYSICAL TENSOR AND APPLICATION, by Z.
Karni. Final scientific rept. Oct. 4, 1964, 46p. incl.
refs. (AFOSR-65-0003) (AF EOAR-63-72) AD 610566
                                       Unclassified

The physical tensor as a multilinear vector form, its
resolution with respect to oblique coordinate networks,
the invariancy under resolution, the general tensor de-
rivative and curvilinear derivative for the physical ten-
sor and the curvature tensors of degree m are intro-
duced. The construction of tensor and generalized dif-
ferential invariants and their application as integrity
bases for some types of singular and quasi-singular
multilinear vector forms are discussed. (Contractor's
abstract)

2765

Technion-Israel Inst. of Tech. Dept. of Mechanics,
Haifa.

A UNIFIED EQUATION OF MOTION IN THE NON-
RELATIVISTIC MECHANICS, by Z. Karni. [1964] [6]p.
(AFOSR-65-1025) (AF EOAR-63-72) AD 617662
                                       Unclassified

Also published in Israel Jour. Tech., v. 2: 267-294,
1964.

An equation is presented describing the motion of the
continua, as well as of the particle and the rigid body,
in terms of the tensor derivative of physical tensors,
the space-time derivative and the first and second
curvature tensors. (Contractor's abstract)

2766

Technion-Israel Inst. of Tech. [Dept. of Physics] Haifa.

REMOVAL OF ORBITAL DEGENERACY IN AN ASYM-
METRIC MOLECULAR ENVIRONMENT, by M. Brith
and O. Schnepp. [1963] [6]p. incl. rables, refs.
(AFOSR-64-2077) (AF 61(052)426)   Unclassified

Also published in Jour. Chem. Phys., v. 39: 2714-
2719, Nov. 15, 1963.

An investigation is made of the covalent and the disper-
sion interaction between an impurity metal atom and the

host rare gas crystal lattice. The contributions of
these interactions to the splitting energy of the atomic
excited P state of magnesium in a distorted lattice site
in solid argon are calculated. It is concluded that the
experimental observations can be accounted for on the
basis of physically reasonable models of asymmetric
impurity sites and in particular the occurrence of more
than one vacancy in the neighborhood of the impurity
atom satisfies all requirements. (Contractor's
abstract)

2767

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

DYNAMIC MAGNETORESISTANCE LOOPS OF COLD
WORKED NICKEL AT LOW TEMPERATURES, by A. A.
Hirsch, N. Friedman, and A. Zvikelsky. [1963] [2]p.
incl. diagrs. (AFOSR-64-0422) (AF 61(052)461)
                                       Unclassified

Also published in Cryogenics, v. 3: 242-243, Dec. 1963.

This letter reports on dynamic magnetoresistance meas-
urements carried out on cold rolled sheets of pure
nickel down to liquid helium temperatures. It was con-
cluded that the duration of a magnetization jump is
longer in a cold rolled sheet having a large reduction in
the thickness than in a normal bulk material. This dura-
tion increases appreciably at liquid helium tempera-
tures.

2766

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

TIME AND FIELD EFFECTS IN THE ELECTRICAL
CONDUCTION OF THIN METALLIC LAYERS AT LOW
TEMPERATURES, by A. A. Hirsch and N. Friedman.
[1964] [9]p. incl. diagrs. (AFOSR-64-1207) (AF 61-
(052)461) AD 443015   Unclassified

Also published in Physica, v. 30: 369-397, 1964.

The electrical resistance of thin metallic layers meas-
ured by a bridge operated at 2400 Hz shows a creep
phenomenon when a static electric field is introduced
along the direction of the flowing alternating current.
This resistance creep is responsible also for observed
time-dependent hysteresis loops of the ac resistance.
The phenomenon has been investigated from room down
to liquid helium temperatures in layers made from
silver, cobalt and nickel. A linear relation is found be-
tween the logarithm of the change in the ac resistance
and the square root of the time measured from the mo-
ment when the longitudinal static field was applied. The
creep phenomenon increases with the increasing static
field. The theoretical model for the resistance creep
gives an explanation for the deviation in Ohm's law ob-
served in thin metallic layers at low temperatures.
(Contractor's abstract)

2789

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

ELECTRICAL CONDUCTION OF THIN METALLIC
LAYERS AT HIGH FREQUENCIES DOWN TO LIQUID
HELIUM TEMPERATURES, by A. A. Hirsch and S.
Bazian. [1964][7]p. incl. diagrs. table, refs. (AFOSR-
64-1208) (AF 61(052)481) AD 443016   Unclassified

Also published in Physica, v. 30: 258-264, 1964.

The dependence of electrical conduction on current fre-
quency has been studied in thin layers of pure metals at
temperatures between 4.2°K and 297°K. The experi-
mental data are given for frequencies up to 2 x 10⁶ Hz.
As shown by the experimental data the increase in elec-
trical resistance with the increase of the frequency is
more pronounced in layers having large dc resistance.
In layers with negative temperatures coefficients of re-
sistance, this decrease is more rapid at low tempera-
tures.

2790

Technion-Israel Inst. of Tech. [Dept. of Physics] Haifa.

EFFECT OF COLD ROLLING ON MAGNETIZATION
REVERSAL OF HIGH-PURITY NICKEL TAPES, by
A. A. Hirsch. [1964][2]p. (AFOSR-64-1209) (AF 61-
(052)481) AD 443017   Unclassified

Also published in Jour. Appl. Phys., v. 35: 909-910,
Mar. 1964.

Dynamic magnetoresistance hysteresis loops were used
for investigation of the magnetization reversal in cold-
rolled tapes of high-purity nickel. When the magnetiza-
tion field was transverse to the rolling axis, the coer-
cive force could be expressed in a form which may be
related to a magnetization reversal occurring through
a process of reorientation of spins. The magnetore-
sistance loops of the samples made by unidirectional
cold rolling were asymmetric when they were performed
by applying simultaneously two crossed magnetic fields,
one ac and the other dc. A magnetic uniaxial anisotropy
induced by this rolling seems to be responsible for the
observed asymmetry, a possible mechanism for this
being the deformation of crystals by slips. (Contrac-
tor's abstract, modified)

2791

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

THE INFLUENCE OF COLD WORK ON THE MAGNETO-
RESISTANCE EFFECT OF PURE FERROMAGNETIC
METALS AT LIQUID HELIUM TEMPERATURES.
PART I. MAGNETORESISTANCE IN THIN FILMS OF
PURE FERROMAGNETIC METALS, by A. A. Hirsch.
Final scientific rept. Jan. 1961-Apr. 1964, June 15,
1964, 85p. incl. illus. diagrs. tables, refs. (AFOSR-
64-1894, pt. 1) (AF 61(052)481)   Unclassified

The electrical conduction and the magnetoresistance
effect of thin metallic films made by evaporation in a
high vacuum were investigated down to liquid helium

temperatures as a function of the electric field, the
frequency of the current, as well as the simultaneously
applied static and variable magnetic fields. The dif-
ferent dependences were interpreted in terms of a gran-
ular structure of the films. The grains of the ferromag-
netic films were assumed to be one-domain single
crystals. (Contractor's abstract)

2792

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

THE INFLUENCE OF COLD WORK ON THE MAGNETO-
RESISTANCE EFFECT OF PURE FERROMAGNETIC
METALS AT LIQUID HELIUM TEMPERATURES.
PART II. MAGNETORESISTANCE AND DEFORMATION
TEXTURES IN COLD ROLLED PURE NICKEL, by A. A.
Hirsch. Final scientific rept. Jan. 1961-Apr. 1964,
Aug. 15, 1964, 74p. incl. illus. diagrs. refs (AFOSR-
64-1894, pt. 2) (AF 61(052)481)   Unclassified

A phenomenological analysis is outlined for the mag-
netoresistance effect in cold rolled pure nickel below
magnetization saturation down to liquid helium tempera-
tures, which is based on the assumption of time depen-
dent hysteresis phenomena. X-ray texture studies are
also used in the interpretation of the experimental data
on low temperature magnetoresistance. The results
are compared with those obtained from magnetoresis-
tance investigations on thin films of pure ferromagnetic
metals. (Contractor's abstract)

2793

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

MAGNETIZATION SWITCHING TIME AT LOW TEM-
PERATURES, by A. A. Hirsch. [1964][2]p. incl.
diagr. table. (AFOSR-64-2097) (AF 61(052)481)
AD 451351   Unclassified

Also published in Physica, v. 30: 563-564, 1964.

This letter reports a new simple experimental method
for investigation of magnetization switching time at low
temperatures, which is based on the study of dynamic
magnetoresistance hysteresis loops obtained by using a
triangular waveform magnetizing field.

2794

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

MAGNETORESISTANCE BELOW MAGNETIZATION
SATURATION IN PLASTICALLY DEFORMED NICKEL
DOWN TO LIQUID HELIUM TEMPERATURES, by A. A.
Hirsch. [1964][12]p. incl. diagrs. refs. (AFOSR-65-
0765) (AF 61(052)481) AD 616038   Unclassified

Also published in Physica, v. 30: 1545-1556, 1964.

A phenomenological analysis is outlined for the mag-
netoresistance effect in plastically deformed pure nickel
below magnetization saturation down to liquid helium
temperatures, which is based on the assumption of time

dependent hysteresis phenomena. Both preferred orientation and induced uniaxial magnetic anisotropy are expected to be created by the plastic flow, when the deformation of the polycrystalline material is carried out by cold rolling with high reduction in the thickness of the sample. The magnetoresistance hysteresis loops can be ascribed to a magnetization process, and the field interval corresponding to nonsaturated states of magnetization is higher than expected in ordinary bulk material.

2795

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

THE EFFECT OF FREQUENCY ON THE ELECTRICAL RESISTIVITY OF GRANULAR METAL FILMS, by A. A. Hirsch, N. Friedman, and S. Bazian. [1964] [2]p. incl. diagr. table, refs. (AFOSR-65-0748) (AF EOAR-63-71) AD 615072   Unclassified

Also published in Vacuum, v. 14: 393-394, 1964.

A resistance method is given for the determination of the thickness of thin granular metal films based on the use of impedance measurements at frequencies in order of magnitude of 1 mcps. At these frequencies the intergranular gap resistance can be seen as short circuited by the inter-granular capacitance, so that the measured resistance is that of the metal grains. As shown the resistivity of the individual grains is in general several times greater than the bulk resistivity of the metal. This difference depends strongly on the vacuum conditions and the rates of evaporation.

2796

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

MAGNETIC RELAXATION BEHAVIOUR OF MULTILAYER NICKEL FILMS, by A. A. Hirsch, N. Friedman, and Z. Eliezer. [1964] [3]p. incl. diagrs. (AFOSR-65-1895) (AF EOAR-63-71) AD 625709   Unclassified

Also published in Physica, v. 30: 2314-2316, 1964.

A discussion is presented of the magnetic properties of multilayer films composed of very thin laminations of ferromagnetic metals, starting from the viewpoint of a superparamagnetic state. The films investigated were obtained by depositing alternatively at room temperature layers of nickel and copper in a vacuum of 10^{-6} mm Hg on to substrates made of aluminum foils (70 mm x 100 mm x 0.01 mm). The dependence of the coercive force on the mean distance between the nickel layers of the films indicates that the magnetic interaction between the different layers of the films cannot be neglected in a theoretical interpretation of the remagnetization of multilayer films with superparamagnetic behavior, as is normally done in the case of fine noninteracting particles, the remagnetization of which is discussed by means of a Langevin function.

2797

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

A GENERAL METHOD FOR THE USE OF BAND MODELS WITH APPLICATIONS TO INFRARED ATMOSPHERIC ABSORPTION, by U. P. Oppenheim and Y. Ben-Aryeh. [1964] [12]p. incl. diagrs. refs. (AFOSR-64-2250) (AF EOAR-63-111) AD 452358
Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 4: 559-570, 1964.

A new method is described for the application of band models to an observed absorption spectrum. It is shown how the appropriate model (Elasser or statistical) is selected by a simple analysis of the observed spectral data. Once the model has been chosen, the two main parameters of each model are derived by the use of curves of growth. The method is applied to the following atmospheric bands: N_2O (at 4.5μ), CO (at 4.7μ) and H_2O (at 6.3μ). For each band the parameters of the appropriate band model are calculated for a large number of frequencies in the band. (Contractor's abstract)

2798

Technische Hochschule, Hannover (Germany).

INVESTIGATION OF PLATE AND SHELL MODELS BY MATRICES, by E. Pestel. May 1963, 174p. (AFOSR-64-0592) (AF EOAR-61-46) AD 434846
Unclassified

Grid models for arbitrary triangular and trapezoidal shapes are developed, and the effect of shear deformation in bending problems is included. A straightforward method for the application of Hrennikoff's models to shell problems was derived. Also a concise method for the derivation of the stiffness-matrix for Hrennikoff's model is developed. Finally, the use of transfer matrices is discussed for certain basic problems concerning the lumped parameter technique which is ordinarily employed in conjunction with grid models for vibration problems and for the case of random-vibrations which are dealt with via the frequency response of the structure.

2799

Technische Hochschule, Munich (Germany).

STUDIES ON THE CHANGE OF THE CONCENTRATIONS OF INTERMEDIATES DURING PHOTOSYNTHESIS OF CHLORELLA AND ISOLATED CHLOROPLASTS, by O. Kandler. Final rept. no. 1, May 1, 1963, 27p. (AFOSR-64-0021) (AF EOAR-62-42) AD 429777
Unclassified

The changes in the concentrations of intermediates and the distribution of C_{14} after photosynthesis in $C_{14}O_2$ by Chlorella and isolated chloroplasts was

measured under different conditions of photosynthesis and under the effect of metabolic inhibitors. The following results were obtained. (1) The changes in the concentrations of intermediates in Chlorella during the transition from light to dark and vice versa are independent of CO_2, but dependent on anaerobiosis. (2)

In Chlorella photosynthesis is inhibited even by a concentration of monoiodoacetic acid which is 100 times lower than that inhibiting respiration. The beginning of inhibition is indicated by an accumulation of labeled PGA. (3) When Chlorella is illuminated in the presence of KCN, the radioactive PGA formed during a preceding period of photosynthesis in $C_{14}O_2$, is still reduced to sugar without a change in the total quantity of PGA in the cell. (4) Arsenate and DNP do not lead to an accumulation of PGA, but do inhibit the formation of RuDP. (5) The distribution of radioactivity on the paper chromatograms showed that ATP and ADP are the first labeled compounds under the two conditions.

2800

Technische Hochschule, Munich (Germany).

[DIFFERENCE METHOD FOR HYPERBOLIC INITIAL VALUE PROBLEMS WITH MORE THAN TWO INDEPENDENT VARIABLES BY USING SEMI-CHARACTERISTICS] Differenzenverfahren für hyperbolische Anfangswertprobleme bei mehr als zwei unabhängigen Veränderlichen mit Hilfe von Nebencharakteristiken, by R. Sauer. [1963] [13]p. incl. diagrs. (AFOSR-J649) (AF EOAR-62-94) AD 418156   Unclassified

Also published in Numerische Math., v. 5: 55-67, 1963.

The method developed is for m > 2 quasi-linear partial differential equations with m > 2 independent variables. It is assumed that the problem is properly posed and hyperbolic. This method uses compatability conditions in the characteristic planes, but uses semi-characteristic directions instead of bi-characteristic directions. directions. This new approach is more flexible and can be used for practical computation.

2801

Technische Hochschule, Munich (Germany).

PRACTICAL NUMERICAL METHODS OF THREE-DIMENSIONAL SUPERSONIC FLOWS, by R. Sauer. Final technical rept. June 1, 1963, 14p. (AFOSR-J1213) (AF EOAR-62-94) AD 423081   Unclassified

Two new difference methods for the numerical solution of initial value problems in quasilinear partial differential equations were developed. One of these methods is applied to problems of the propagation of non-linear pressure waves. Some other investigations now under way, concerning questions in quasilinear equations are briefly discussed.

2802

Technische Hochschule, Munich (Germany).

[SIMPLE WAVES IN THE THEORY OF CHARACTERISTICS OF A SYSTEM OF QUASILINEAR PARTIAL DIFFERENTIAL EQUATIONS] Einfache Wellen in der Charakteristikentheorie von Systemen quasilinearer partieller Differentialgleichungen, by R. Sauer. [1964] [7]p. (AFOSR-64-2415) (AF EOAR-62-94) AD 453610
                                             Unclassified

Also published in Zeitschr. Angew. Math. und Mech., v. 44: 203-209, 1964.

For systems of homogeneous quasilinear differential equations with n independent variables simple wave solutions are deduced with the help of the theory of characteristics. It is assumed that the coefficients of the differential equations do not explicitly depend on the independent variables. For the sake of illustration, applications in gasdynamics (propagation of nonlinear pressure waves) are discussed. (Contractor's abstract)

2803

Technische Hochschule, Munich (Germany).

EXPERIMENTS ON THE EFFECTS OF COMBINED WAVELENGTHS ON PHOTOSYNTHESIS, by O. Kandler. Final technical rept. May 1, 1964, 13p. incl. diagrs. tables. (AFOSR-64-1650) (AF EOAR-63-10) AD 606077   Unclassified

An apparatus for measuring photosynthesis of Chlorella or other algae under the influence of combined monochromatic beams of light are described. Preliminary experiments showed, that the addition of blue light to red light results in a decrease the addition of far red light in an enhancement of photosynthesis. (Contractor's abstract)

2804

Technische Hochschule, Munich (Germany).

EXPERIMENTAL RESULTS ON THE METHOD OF "NEBENCHARAKTERISTIKEN", by W. Werner. June 15, 1964 [11]p. incl. diagrs. tables. (Scientific rept. no. 1) (AFOSR-64-1604) (AF EOAR-63-77) AD 605507
                                             Unclassified

Systems of hyperbolic partial differential equations in 2 or more space variables are integrated numerically by taking derivatives in 'characteristic hyperplanes'. Numerical results are presented and discussed.

2805

Technische Hochschule, Munich (Germany).

GENERAL MULTISTEP FINITE DIFFERENCE

METHODS FOR THE SOLUTION OF $U_{xy} = f(X, Y, U, U_x, U_y)$, by H. J. Stetter and W. Törnig. [1963] [18]p. incl. diagr. (AFOSR-64-2388) (AF EOAR-63-77) AD 452402   Unclassified

Also published in Rend. Circ. Matem. Palermo, Ser. II, v. 12: 1-18, 1963.

This paper presents an adaptation of the general multi-step finite difference methods to the numerical solution of the partial differential equations. These methods may in a obvious manner be generalized to systems of equations without changing their stability and convergence properties; the presentation was restricted to the scalar case to keep the notation simpler. Since all quasilinear hyperbolic partial differential equations of second order in two independent variables may be transformed into systems, the resulting numerical methods may well have important applications.

2806

Technische Hochschule, Stuttgart (Germany).

EXPERIMENTAL INVESTIGATIONS OF VORTEX OC-CURRENCE AT TRANSITION IN UNSTABLE LAMINAR BOUNDARY LAYERS, by F. X. Wortmann. Final rept. Feb. 10, 1964 [32]p. incl. illus. diagrs. (AFOSR-84-1280) (AF 61(052)220) AD 602796   Unclassified

The behavior of laminar and instably stratified boundary layers towards three-dimensional perturbations, in form of vortices parallel to the direction of flow, was investigated by means of a water tunnel of very low turbulence. For the first time it has been possible to verify the theoretically stated neutral curve of stability. Furthermore the distribution of the disturbation amplitude for different wave lengths and wall distances and also the growth of the vortices in the direction of flow were investigated. These experiments give a verification of the theory of stability and show that the validity of the theory is limited to small disturbation amplitudes. (Contractor's abstract, modified)

2807

Temple U. Research Inst., Philadelphia, Pa.

PLASMA JET CHEMISTRY, by C. S. Stokes, J. A. Cahill and others. Final rept. Dec. 1984, 32p. incl. diagrs. tables. (AFOSR-85-1802) (AF AFOSR-82-196) AD 625591   Unclassified

Three types of plasma jets are described: a noble gases plasma jet, a nitrogen plasma jet, and a plasma jet cathode as chemical feeder. Powder feeding devices and quenching devices are considered. The use of the plasma jet is described for several chemical reactions: metal oxides reduction, refractory metals nitrides formation, and refractory metals carbides formation. The temperatures attainable with plasma jets are in the range of $5000°K$ to $50,000°K$.

2808

Texaco Experiment, Inc., Richmond, Va.

PROPERTIES OF IONS IN FLAMES, by I. R. King. Final rept. June 1959-Feb. 1984, 61p. incl. illus. diagrs. tables, refs. (Rept. no. TP-231) (AFOSR-64-0983) (AF 49(838)850)   Unclassified

The properties of ions in flames, with particular emphasis on those properties related to ion recombination, have been studied by Langmuir probes, electromagnetic attenuation, and mass spectrometry. Recombination rates for both natural flame ions and ions resulting from the introduction of easily ionized materials into the flame have been determined under a variety of conditions of pressure, temperature, and fuel type. Identities of many of the ions have been determined, and a tentative mechanism of ion recombination in hydrocarbon flames has been postulated.

2809

Texas A. and M. Coll. Dept. of Physics, College Station.

ELECTRONIC ABSORPTION SPECTRA OF SIMPLE MOLECULES. Final rept. Mar. 1963, 84p. incl. diagrs. tables, refs. (AFOSR-4728) (AF 49(638)593) AD 403079; AD 407128   Unclassified

This report is a compilation of papers and abstracts with the following titles: The Franck-Condon principle and the structure of excited electronic states of molecules; The structure of benzene in the excited electronic state $^1B_{2u}$; A double-minimum potential function with the application to NH_3 and ND_3; Evidence for a double-minimum potential in an excited state of ClO_2 (Abstract); 'Hot' bands of the 2000 A system of NH_3, ND_3, and NT_3; Rotational structure and intensity envelopes of vibronic bands of sulfur dioxide near 3700 A; and the 2900 A absorption system of sulfur dioxide (Abstract).

2810

Texas A. and M. Coll. [Dept. of Physics] College Station.

EVIDENCE FOR A DOUBLE-MINIMUM POTENTIAL IN AN EXCITED STATE OF ClO_2, by J. B. Coon, F. A. Cesani, and C. M. Loyd. [1983] [8]p. (AFOSR-64-0058) (AF 49(838)593) AD 430675   Unclassified

Also published in Faraday Soc. Discussions, v. 35: 118-123, 1963.

Evidence is presented which indicates the existence of a double-minimum potential in the antisymmetrical vibrational co-ordinate of an excited electronic state of ClO_2. A two-parameter double-minimum potential function is adjusted to fit the observed levels of the Q'3 mode. The resulting function has a barrier of 2520 cm-1, and at each potential minimum one bond is 0.065 A shorter and one bond is 0.065 A longer than the

average bond of 1.620 A. A Franck-Condon calculation based on the vibrational wave functions of the double-minimum potential yields intensity ratios in approximate agreement with the experimental ratios.

2811

Texas Instruments, Inc., Dallas.

PARAMAGNETIC RESONANCE OF Cr IN CdS, by T. L. Estle, G. K. Walters, and M. DeWit. [1963] [11]p. incl. diagrs. refs. (AFOSR-64-0877) (AF 49(638)1250) AD 438670   Unclassified

Also published in Paramagnetic Resonance; Proc. First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), ed. by W. Low. New York, Academic Press, v. 1: 144-154, 1963.

The paramagnetic resonance of Cr in CdS has been studied at low temperatures. Six Cr centers, differing only in their orientation are present in equal numbers. Each resonance has a g $\perp \lesssim 0.02$; consequently no $\Delta M = \pm 1$ transitions are observed. The lines broaden at about 6°K and are unobservable above about 20°K. The hyperfine splitting constants parallel to the z axis of the center are 5.6 gauss for the nearest Cd nuclei and 13.8 gauss for Cr^{53} in an enriched sample. Resonance is attributed to substitutional Cr^{++} with a Jahn-Teller distortion approximately along the directions bisecting the lines to the nearest sulfur neighbors.

2812

Texas Instruments, Inc., Dallas.

ELECTRON PARAMAGNETIC RESONANCE OF IRON IN INDIUM ARSENIDE, by T. L. Estle. [1964] [3]p. incl. table, refs. (AFOSR-65-0773) (AF 49(638)1250) AD 617054   Unclassified

Also published in Phys. Rev., v. 136: A1702-A1704, Dec. 14, 1964.

The electron-paramagnetic-resonance spectrum of the $3d^5$ configuration of iron in cubic symmetry has been observed in iron-doped indium arsenide. The spin-Hamiltonian parameters describing this spectrum are g = 2.035 ± 0.002 and a = + (421 ± 1) x 10^{-4} cm^{-1}. The inhomogeneously broadened line is approximately 130 G wide. A comparison is made with the Mössbauer effect of Fe^{57} in InAs studied by Bemski and Fernandes. The results are discussed in terms of charge-transfer configuration admixtures introduced by Fidone and Stevens and elaborated by Watanabe and co-workers. (Contractor's abstract)

2813

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. X. HALOPENTAMMINECOBALT (III) NITRATES, $Co(NH_3)_5X(NO_3)_2$, by W. W. Wendlandt and

J. P. Smith. [1964] [8]p. (AFOSR-64-0933) (AF AFOSR-63-23) AL 439975   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 445-452, 1964.

The thermal dissociation of the $Co(NH_3)_5X(NO_3)_2$ type complexes was studied by thermogravimetry, differential thermal analysis, thermomagnetic analysis, and by pyrolysis on the mass spectrometer. The TGA curves showed that all of the complexes dissociated in a single step in the temperature range of 130°-290°C. All of the DTA curves were characterized by a large exothermic peak in the 200°-260°C temperature range. The diamagnetic-paramagnetic transition was studied from ambient to 400°C. Pyrolysis products found by the mass spectrometer were H_2O, NH_3, NO, N_2O and N_2.

2814

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

ON THE ALPHA-BETA TRANSITION OF BIS(PYRIDINE) COBALT(II) CHLORIDE, by W. W. Wendlandt. [1964] [2]p. (AFOSR-64-1812) (AF AFOSR-63-23) AD 449083   Unclassified

Also published in Chemist Analyst, v. 53: 71-72, July 1964.

Two forms of bis(pyridine) cobalt(II) chloride, $Co(C_5H_5N)_2Cl_2$, are known: a violet α-form and a blue β-form. Numerous investigations relating to the structure, molecular weight, magnetic properties, absorption spectra, and thermal properties have been made. It is now generally concluded that the α-form involves polymeric chains in which each cobalt is octahedrally surrounded by four chlorine atoms and two nitrogen atoms. The β-form consists of a monomeric structure in which each cobalt is tetrahedrally surrounded by two chlorine atoms and two nitrogen atoms.

2815

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. XII. SOME COPPER(II) AMMINE COMPLEXES, by J. P. Smith and W. W. Wendlandt. [1964] [7]p. (AFOSR-64-1813) (AF AFOSR-63-23) AD 449082   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 1157-1163, 1964.

The thermal dissociation of $(Cu(NH_3)_6)Br_2$, $(Cu(NH_3)_6)Cl_2$, $(Cu(NH_3)_5SO_4)$, and $(Cu(NH_3)_4I_2)$, was studied by differential thermal analysis, thermomagnetic analysis, pyrolysis on the mass spectrometer, and by chemical analysis of the residues and reaction products. The complexes dissociated through the loss of ammonia, forming stable lower ammines, and upon further heating, the reduction of the copper(II) to

copper(I) took place. The stoicheiometry of the thermal dissociation reaction was determined.

2816

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. VII. A THERMOMAGNETIC STUDY OF THE Co(III)-Co(II) REDUCTION IN COBALT(III) AMINE COMPLEXES, by W. W. Wendlandt and J. P. Smith. [1963] [6] p. (AFOSR-64-1815) (AF AFOSR-63-23) AD 449066   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 25: 1267-1272, 1963.

The Co(III)-Co(II) reduction reaction was studied by means of a high temperature Gouy magnetic susceptibility apparatus for the complexes: $(Co(NH_3)_6)X_3$,

$(Co(NH_3)_6)_2(SO_4)_3 \cdot 2 \cdot 5H_2O$, $(Co(NH_3)_5H_2O)X_3$,

$(Co(NH_3)_5X)X_2$, and $(Co(NH_3)_5X)Y_2$. Minimum reduction temperatures were in the $100°-200°$ temperature range with most of them in the $150°-200°$ range. The curves for $(Co(NH_3)_5Br) I_2$ and $(Co(NH_3)5Cl) I_2$ had a pronounced break at $193°$ and $185°$ respectively. Two possible reduction mechanisms are indicated for these two complexes.

2817

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. XIV. SOME RHODIUM(III) AMMINE COMPLEXES, by W. W. Wendlandt and P. H. Franke, Jr. [1964] [9] p. (AFOSR-64-2503) (AF AFOSR-63-23) AD 453798   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 1885-1893, 1964.

The thermal dissociation of $(Rh(NH_3)_6)Cl_3$,

$(Rh(NH_3)_5X)X_2$, and $(Rh(NH_3)_5 H_2O)X_3$ was studied by TGA, DTA, thermomagnetic analysis, and GEA. The stoichiometry of the thermal dissociation reaction of the $(Rh(NH_3)_5X)X_2$ complexes was also determined by analysis of the decomposition products. A comparison was made between the thermal dissociation of the rhodium(III) complexes and the analogous cobalt(III) complexes.

2818

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THE THERMAL DISSOCIATION OF SOME METAL CUPFERRATE CHELATES, by W. W. Wendlandt, S. I. Ali, and C. H. Stembridge. [1964] [8] p. incl. diagrs. table. (AFOSR-65-0378) (AF AFOSR-63-23) AD 612246   Unclassified

Also published in Anal. Chim. Acta, v. 31: 501-508, 1964.

The thermal dissociation of the cupferron complexes with Cu(II), Ni, Co(II), Zn, Cd, Mn(II), Hg(II), Mg, Ca, Ba, Sr, Al, Fe(III), Ce(III), La, and Nd was studied by differential thermal analysis (DTA) and by pyrolysis into a mass spectrometer. The DTA curves consisted mainly of endothermic peaks although some contained exothermic peaks as well. The mass spectrometer showed that cupferron decomposes slightly above room temperature, giving off N_2, NO, N_2O, NH_3 and H_2O.

A mechanism for the thermal dissociation of the copper(II) cupferrate is proposed. (Contractor's abstract)

2819

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. XIII. SOME TETRAMMINEPALLADIUM (II) COMPLEXES, by W. W. Wendlandt and L. A. Funes. [1964] [6] p. incl. diagrs. tables, refs. (AFOSR-65-0379) (AF AFOSR-63-23) AD 612245   Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 1879-1884, 1964.

The thermal dissociation of the palladium(II) tetrammine-complexes, $[Pd(NH_3)_4]X$, was studied by thermogravimetry, DTA, GE, and by analysis of the pyrolysis products. The complexes, except for the nitrate and sulphate, dissociated to give the trans-diammine-complexes, $[Pd(NH_3)_2X]$. The diammine-iodide and bromide complexes dissociated to give the corresponding anhydrous metal halides, PdX_2. The stoicheiometry for the thermal dissociation of the $[Pd(NH_3)_2X]$ complexes, where X was Cl, Br, and I, was determined. (Contractor's abstract)

2820

Texas U. Computation Center, Austin.

MATHEMATICAL PROGRAMMING BY MINIMIZING DIFFERENTIABLE FUNCTIONS, by A. A. Goldstein and B. R. Kripke. [1964] [2] p. (AFOSR-64-0968) (AF AFOSR-63-467) AD 440145   Unclassified

Also published in Numerische Math., v. 6: 47-48, 1964.

This note is concerned with the possibility of using classical techniques for minimizing differentiable functions without constraints to find approximate solutions to certain constrained problems.

2821

Texas U. [Computation Center] Austin.

MINIMIZING FUNCTIONALS ON HILBERT SPACE, by

A. A. Goldstein. [1964] [7]p. (AFOSR-65-1020)
(AF AFOSR-62-346 and AF AFOSR-63-467) AD 616351
Unclassified

Also published in Computing Methods in Optimization
Problems; Proc. of Conf., California U., Los Angeles
(Jan. 30-31, 1964), ed. by A. V. Balakrishnan and
L. W. Neustadt. New York, Academic Press, 1964,
p. 159-165.

This note involves 2 ideas. The first is a generalization
of constructive techniques employed for the minimiza-
tion of quadratic functionals on a real Hilbert space.
The extension is for twice differentiable functionals.
The second consists of using differentiable functionals
to make uniform approximations of nondifferentiable
functionals in related examples. Of the 2 examples
given, one arises from control theory, the other from
approximation theory in the L_1 metric. In both prob-
lems the functional is minimized on a closed linear
variety.

2822

Texas U. [Computation Center] Austin.

MINIMAX THEOREMS AND CONJUGATE SADDLE-
FUNCTIONS, by R. T. Rockafellar. [1964] [23]p.
incl. table. (AFOSR-65-1164) (AF AFOSR-63-467)
AD 622636   Unclassified

Also published in Math. Scand., v. 14: 151-173, 1964.

Saddle-elements in minimax theory are studied which
are not completely closed, but merely closed. Convex
functions and saddle-functions with infinite values are
first considered. Three theorems are later presented
on the existence and properties of minimax equivalence
classes of closed saddle-functions. Several sections
deal with conjugates of closed saddle-functions and the
subgradient characterization of saddle-points. Finally
the main minimax theorem is presented concerning
two conditions over a saddle element {A, B, K} such that
if the first condition is satisfied

$$\max_{x \in A} \inf_{y \in B} K(x, y) = \inf_{y \in B} \sup_{x \in A} K(x, y) < +\infty,$$

and if the second condition is satisfied

$$-\infty < \sup_{x \in A} \inf_{y \in B} K(x, y) = \min_{y \in B} \sup_{x \in A} K(x, y),$$

then K has a saddle-point on A x B.

2823

Texas U. Dept. of Chemistry, Austin.

SOME ASPECTS OF TRANSITIONS BETWEEN ELEC-
TRONIC LEVELS, by W. A. Noyes, Jr. and L. Unger.
[1964] [12]p. incl. refs. (AFOSR-65-0890) (AF AFOSR-
65-778) AD 617936   Unclassified

Also published in Pure and Appl. Chem., v. 9: 461-
472, 1964.

The transitions between electronic levels of pol~   .lc
molecules and their relationship to the photoc.   tr~
of such molecules are considered. These trans....ons

often occur without emission or absorption of radiation
so that the state first formed by the absorption of ra-
diation may not be the one most concerned with the re-
sulting reaction kinetics. The present discussion re-
views the data for a few polyatomic molecules, i.e.,
ketone, acetone, biacetyl, benzene, and ketones with
C atoms γ to the carbonyl group, to determine both the
extent of and the character of intersystem cross-overs
and of internal conversions. The terms internal con-
version and intersystem cross-over refer to a non-ra-
diative transition between states of the same multi-
plicity and of different multiplicity, respectively. The
scope of the subject is limited to the gas phase.

2624

Texas U. [Dept. of Engineering Mechanics] Austin.

CYCLIC DEFORMATION OF THIN FILMS INSIDE THE
ELECTRON MICROSCOPE, by F. H. Tuley and M. A.
Wilkov. Dec. 1964, 18p. (Rept. no. EMRL-RM-1001)
(AF AFOSR-64-560) AD 616263   Unclassified

High purity silver and nickel films were obtained by
vapor deposition onto a sodium chloride crystal in an
ion pumped vacuum at a pressure greater than 10^9 Torr.
The electron micrographs showed dislocations, stack-
ing faults and interference fringes present and that the
films were not of uniform thickness. The results
showed that metallic films could be obtained and that the
attainment of films representative of the bulk material
requires a refinement of the vapor deposition method
under ultra-high vacuum conditions.

2625

Texas U. Dept. of Geology, Austin.

PRECAMBRIAN GEOLOGY OF SOUTH-CENTRAL NEW
MEXICO, by W. R. Muehlberger and R. E. Denison.
[1964] [8]p. incl. diagrs. refs. (AFOSR-65-2909)
(AF 49(636)1115) AD 455523   Unclassified

Also published in Fifteenth Field Conf., New Mexico
Geological Soc., 1964, p. 32-69.

The Ruidoso country contains no Precambrian outcrops
and no wells in the region to penetrate to it. To in-
terpret the Precambrian geology of the actual field trip
area a larger area was selected which gives sufficient
regional control for interpolation into the Ruidoso
country. The extensive outcrop belt of the San Andres
Mountains, Sierra Oscura, Los Pinos and southern
Manzano Mountains form the western flank; the expos-
ures in southern Torrance County as well as the nu-
merous wells along the western margins of some of the
Precambrian belts in eastern New Mexico forms the
eastern in Otero County north of the Tertiary intrusive
rocks that extend into Trans-Pecos Texas. This con-
tribution furnishes petrographic descriptions of base-
ment well and outcrop samples and a synthesis of Pre-
cambrian history in the map area.

2826

Texas U. [Dept. of Geology] Austin.

BURIED BASEMENT ROCKS OF THE UNITED STATES
OF AMERICA AND CANADA. VOL. 1 OF 2 AND MAPS,
by W. R. Muehlberger, R. E. Denison, and E. G.
Lidiak. Final rept. Aug. 1964, 213p. (AF 49(638)1115)
AD 449?90   Unclassified

A map of the geology of the buried basement of the
United States and Canada is presented. In addition the
map attached to this report includes the U. S. Geologi-
cal Survey compilation of the exposed basement. The
accompanying report includes brief descriptions of the
rock units recognized and their inferred sequence of
formation, insofar as possible. Also included are (1)
the locations and rock type of each sample studied
petrographically by the contract personnel during the
course of the study; (2) specific gravity of cores avail-
able to us; and (3) isotopic ages of all rocks analyzed
as part of this contract by members of the Isotope
Geology Branch, U. S. Geological Survey.

2827

Texas U. [Dept. of Geology] Austin.

LATE PALEOZOIC MOVEMENT ALONG THE TEXAS
LINEAMENT, by W. R. Muehlberger. 1964, 9p.
(AF 49(638)1115) AD 817442   Unclassified

Also published in Trans. New York Acad. Sci., Series
II, v. 27: 385-392, Feb. 1965.

The Texas Lineament is a zone of structural discon-
tinuity extending in a west-northwest direction from
south of Corpus Christi to El Paso and westward across
southern Arizona to the Transverse Ranges of southern
California. About 200-250 miles of right-lateral slip
took place along this lineament during the late Paleozoic.
Geological evidence is presented as the basis for two
lines of reasoning in support of this interpretation.

2828

Texas U. Dept. of Physics, Austin.

CYCLOTRON RESONANCE IN SLIGHTLY IONIZED
GASES, by F. C. Fehsenfeld. [1963] [9]p. incl. illus.
diagrs. tables, refs. (AFOSR-64-1475) (AF AFOSR-
82-270) AD 445170   Unclassified

Also published in Jour. Chem. Phys., v. 39: 1653-
1661, Oct. 1, 1963.

The conductivity of a slightly ionized gas in a uniform
magnetic field has been obtained from the solution of
the Boltzmann equation for cases in which the collision
frequency between electrons and neutral particles are
dependent on the electron velocity. The line shapes of
the cyclotron resonance absorption of energy from a
high-frequency electric field and the derivative with
respect to the magnetic field of the resonance absorp-
tion have been computed.

2829

Texas U. Dept. of Physics, Austin.

THE PHYSICS OF METASTABLE SYSTEMS, by W. W.
Robertson. Final rept. Feb. 1, 1962-Jan. 31, 1963,
8p. incl. refs. (AFOSR-65-1048) (AF AFOSR-82-270)
AD 822887   Unclassified

The research on this project has included the following
studies: (1) De-excitation cross sections in units of
10^{-16} cm^2 were determined for metastable helium
atoms He(2^3S) and He(2^1S); (2) Reactions of the meta-
stable helium triplets He(2^3S) and He$_2$($^3\Sigma_u^+$) with Ne,
N$_2$, O$_2$, and CH$_4$ were investigated; (3) Metastable
helium atom concentrations in the earth's atmosphere
were calculated; (4) The processes of metastable
destruction were considered in detail; (5) Cross sec-
tions for zero activation energy processes were calcu-
lated and analyzed by simple collision models with em-
phasis on the Penning effect; and (6) The electronic en-
ergy of the system He(^{1}S) and He(^{3}S) was calculated as
a function of nuclear separation. A technical resume
of the results is presented.

2830

Texas U. [Dept. of Physics] Austin.

SOME EXCITED STATES OF THE HYDROGEN MOLE-
CULE. I. $1\Pi_u$(1s2pΠ) AND $3\Pi_u$(1s2pΠ), by J. C.
Browne. [1964] [4]p. incl. diagrs. tables, refs.
(AFOSR-64-2419) (AF AFOSR-63-215) AD 453809
                                   Unclassified

Also published in Jour. Chem. Phys., v. 40: 43-46,
Jan. 1, 1964.

Theoretical potential curves, spectroscopic constants,
and expectation values for some one-electron operators
are given for the $^3\Pi_u$(1s2pΠ) (metastable) and $^1\Pi_u$
(1s2pΠ) states of the hydrogen molecule. Total ener-
gies are 0.7188 and 0.7381 a.u. for $^1\Pi_u$ and $^3\Pi_u$,
respectively. The experimental total energies are
0.7186 and 0.7381 a.u. for $^1\Pi_u$ and $^3\Pi_u$, respectively.

The maximum in the potential curve of the $^1\Pi_u$ state is
found to be much smaller and to occur at a larger inter-
nuclear separation than estimated by previous theoreti-
cal calculations. The $^1\Pi_u$ curve is reasonably con-
sistent with the previous data.

2831

Texas U. Dept. of Physics, Austin.

BINDING ENERGY OF LiH$^+$ AND THE IONIZATION
POTENTIAL OF LiH: MIXED BASIS SET CALCULA-.
TION, by J. C. Browne. [1964] [4]p. incl. tables, refs.
(AFOSR-68-2798) (AF AFOSR-63-215) AD 844859
                                   Unclassified

Also published in Jour. Chem. Phys., v. 41: 3495-3498, Dec. 1, 1964.

A rigorous lower bound of 0.038 ev for the binding energy of LiH+ has been obtained via an ab initio quantum mechanical calculation using a generalized valence-bond wavefunction with a mixed basis set of elliptic and Slater-type orbitals. The probable error in the total energy of LiH+ is 0.15 ev. This invalidates the conclusion of a previous SCF-MO calculation which gave a substantial minimum in the LiH+ potential curve. A rigorous upper bound of 7.91 ev for the ionization potential of LiH is found by the relation E(LiH+, calculated) - E(LiH, experimental) ≥ I.P. (LiH). A probable lower bound for I.P. (LiH) is 7.8 ev. Potential curves for the system Li+ + H from several wavefunctions are tabulated. (Contractor's abstract)

2832

Texas U. Dept. of Physics, Austin.

SOME EXCITED STATES OF THE HYDROGEN MOLECULE. II. $^1\Pi_g(1s2p\pi)$, $^3\Pi_g(1s2p\pi)$, $^1\Delta_g(1s3d\delta)$, $^3\Delta_g(1s3d\delta)$, $^1\Delta_u(1s3d\delta)$, $^3\Delta_u(1s3d\delta)$, by J. C. Browne. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-66-2799) (AF AFOSR-63-215) AD 644936   Unclassified

Also published in Jour. Chem. Phys., v. 41: 1583-1586, Sept. 15, 1964.

Complete theoretical potential curves for the bound states of H_2 and for the long-range portions of the repulsive states of H_2 are reported. Comparison of these results plus results from Paper I of this series to the conventional perturbation theory computations for the long-range interactions of those states shows that the conventional perturbation results may be misleading if "valence" and "overlap" forces are not considered.

2833

Texas U. Dept. of Physics, Austin.

SPECTRA EXCITED IN A HELIUM AFTERGLOW, by C. B. Collins and W. W. Robertson. [1964] [12]p. incl. illus. diagrs. table, refs. (AFOSR-64-1476) (AF AFOSR-63-273) AD 445173   Unclassified

Also published in Jour. Chem. Phys., v. 40: 701-712, Feb. 1, 1964.

The selective excitation of spectra by collisions of the second kind with active helium species was examined in a flowing helium afterglow. Techniques for titrating for the active species in the afterglow are described. Conditions under which a metastable atom, the atomic ion, or the molecular ion predominate in the burner are found and the spectra excited by each are listed.

2834

Texas U. Dept. of Physics, Austin.

HELIUM AFTERGLOW. II. MOLECULAR SPECTRUM, by C. B. Collins and W. W. Robertson. [1964] [4]p. incl. illus. diagrs. refs. (AFOSR-64-1477) (AF AFOSR-63-273) AD 445175   Unclassified

Also published in Jour. Chem. Phys., v. 40: 2208-2211, Apr. 15, 1964.

Spectroscopic investigations of a flowing helium afterglow revealed the presence of strong bands of He_2. An examination of the axial variation and pressure dependence of the intensity of the emission and He_2^+ concentration, as evidenced by titration, served to identify the dominant reaction populating the excited molecular states as being the collisional-radiative recombination of He_2^+. (Contractor's abstract)

2835

Texas U. Dept. of Physics, Austin.

SPECTRA EXCITED IN AN ARGON AFTERGLOW, by J. F. Prince, C. B. Collins, and W. W. Robertson. [1964] [8]p. incl. illus. diagrs. table. (AFOSR-64-1481) (AF AFOSR-63-273) AD 445167   Unclassified

Also published in Jour. Chem. Phys., v. 40: 2619-2626, May 1, 1964.

The selective excitation of electronic spectra of gases by collisions of the second kind with energetic species in an argon afterglow has been investigated. A discharge was excited by a dc source in a high-velocity argon stream which was allowed to interact subsequently with 14 different gases in a reaction chamber several centimeters downstream. The nonluminous argon stream entering the reaction chamber through a nozzle formed cone-shaped diffusion flames in the chamber. Results of the spectroscopic investigation of the flames are presented together with the reaction mechanisms. The observed states of excitation as well as the conditions of the discharge indicate that the exciting species are the argon metastables $^3P_2$ and $^3P_0$. (Contractor's abstract)

2836

Texas U. Dept. of Physics, Austin.

HELIUM AFTERGLOW. I. ATOMIC SPECTRUM, by C. B. Collins and W. W. Robertson. [1964] [7]p. incl. illus. diagrs. refs. (AFOSR-64-1482) (AF AFOSR-63-273) AD 445168   Unclassified

Also published in Jour. Chem. Phys., v. 40: 2202-2208, Apr. 15, 1964.

Spectroscopic investigation of a flowing helium afterglow revealed the presence of strong lines of neutral helium. An examination of the population distribution of the excited atomic states revealed the presence of a Saha

equilibrium between the upper states and the free electrons indicating that the primary process of populating these states was the collisional-radiative recombination of He+. A comparison of the axial variation and pressure dependence of the intensity of the emission with the He_2^+ and He^+ concentrations strengthened this conclusion. (Contractor's abstract)

2637

Texas U. Dept. of Physics, Austin.

SPECTRAL EMISSION OF THE HELIUM AFTERGLOW, by F. E. Niles and W. W. Robertson. [1964] [6]p. incl. diagrs. table, refs. (AFOSR-64-1483) (AF AFOSR-63-273) AD 445169   Unclassified

Also published in Jour. Chem. Phys., v. 40: 2909-2914, May 15, 1964.

The spectral emission from a dc pulsed helium discharge for pressures from 5 to 30 Torr has been investigated during the early afterglow using a spectrometer with gated photomultiplier and from the early afterglow through the late afterglow using interference filters with gated photomultiplier. The afterglow spectrum was predominately that of molecular light which was attributed to the collisional-radiative recombination of molecular ions. The time-decay of molecular light at late times indicated ambipolar diffusion control by an ion with a $D_a p$ of 710 ± 10 cm^2/sec, which corresponds to a μ_0 of 16.4 ± 0.2 $cm^2/V \cdot sec$, in good agreement with values reported for the helium molecular ion employing other techniques. (Contractor's abstract)

2836

Texas U. Dept. of Physics, Austin.

THE MOLECULAR SPECTRUM IN A HELIUM AFTERGLOW, by C. B. Collins, W. B. Hurt, and W. W. Robertson. [1964] [6]p. incl. illus. diagrs. (AFOSR-64-1674) (AF AFOSR-63-273) AD 448257
        Unclassified

Also published in Proc. Third Internat'l. Conf. on Physics of Electronic and Atomic Collisions, London (Gt. Brit.) (July 22-26, 1963), Amsterdam, North Holland Publishing Co., 1964, p. 517-524.

A visible afterglow was obtained when purified helium was passed at high velocity through a microwave discharge. The appearance was of a bright pinkish-violet column tailing downstream from the discharge. The length of the afterglow in a particular system varied from a few to fifteen or more centimeters, depending upon the pressure. Both atomic and molecular radiation was observed in the afterglow and the variation in intensity with pressure (5 to 45 mm Hg) and time (60 to 250 μsec from discharge) indicates the origin of the radiation. (Contractor's abstract)

2639

Texas U. Dept. of Physics, Austin.

THE PHYSICS OF METASTABLE SYSTEMS, by W. W. Robertson. Final rept. Feb. 1, 1963-Jan. 31, 1964. 6p. incl. refs. (AFOSR-65-1047) (AF AFOSR-63-273) AD 619099   Unclassified

The interest of this project centered on the energy-rich metastable states of the rare gases. For example, the helium triplet metastable (2^3S) lies 19.6 ev above the ground state and has a calculated radiative half-life of approx 10^5 sec. The experimentally observed half-life is usually of the order of tens of msec depending upon the other destructive processes operating, i.e., diffusion to the walls with deactivation, collisional deactivation by superelastic collisions with electrons, 3-body conversion to molecules, Penning-type reactions with impurities, etc. It was the basic aim of this project to investigate these processes, and to establish the mechanism and cross sections or rate constants for these various reactions along with the temperature dependence.

2640

Texas U. Dept. of Physics, Austin.

QUATERNIONS IN RELATIVITY, by P. Rastall. [1964] [13]p. incl. refs. (AFOSR-65-1017) (AF AFOSR-65-454) AD 616354   Unclassified

Also published in Rev. Modern Phys., v. 36: 620-632, July 1964.

In this note the quaternion formalism is applied to special relativity and Riemannian space-time. Though quaternions introduce some difficulties in manipulation, they combine the advantages of spinor calculus and the matrix notations of Pauli and Dirac, in that one can write field equations in terms of quaternions which correspond to generalizations of the Pauli spin matrices, and which at the same time have a clear physical meaning as the vectors of the reference tetrad. An account of quaternion algebra and an introduction to the tetrad formalism of Riemannian geometry is given. Quaternions are applied to special relativity through quaternion concepts of Lorentz vectors and spinors, and to Riemannian space-time through the tetrad formalism of Riemannian geometry.

2641

Texas U. Dept. of Physics, Austin.

ROTATIONS AND LORENTZ TRANSFORMATIONS, by P. Rastall. [1964] [17]p. (AFOSR-65-1018) (AF AFOSR-63-454) AD 617799   Unclassified

Also published in Nuclear Phys., v. 57: 191-207, 1964.

Any complex 3-dimensional rotation is determined by a complex vector and by a complex angle of rotation. New, short proofs are given of the homomorphisms between the 3-dimensional complex rotation group, the

group of unimodular quaternions or unimodular 2 x 2 matrices, and the restricted Lorentz group. A correspondence is established between certain complex 3-dimensional rotation vectors and 2-dimensional subspaces of Lorentz vectors. The 2-dimensional subspaces which are invariant under a given restricted Lorentz transformation are shown to be determined by those eigenvectors of the corresponding 3-dimensional rotation matrix which belong to real eigenvalues. For non-null restricted Lorentz transformations this leads to a proof of Synge's theorem. (Contractor's abstract)

2842

Texas U. [Dept. of Physics] Austin.

INSTABILITY OF THE EQUIPARTITION STATE IN A FLUID SPHERE, by J. Kristian. [1964] [11]p. incl. diagrs. (AFOSR-65-1019) (AF AFOSR-63-454) AD 618618   Unclassified

Also published in Astrophys. Jour., v. 140: 257-267, July 1, 1964.

Perturbations of a toroidal equipartition state in a homogeneous, compressible sphere are investigated in the tensor virial approximation. The equipartition state mixes the radial pulsation and the lowest-order Kelvin oscillation of the sphere. For any fluid, the sphere is unstable if the magnetic energy $\mathfrak{M}$ exceeds a critical value. This value depends upon γ, the ratio of specific heats of the fluid, but in no case is it larger than 1/3 of the gravitational energy of the sphere. For $\gamma < 8/5$, it is the radial mode which becomes unstable; for $\gamma = 8/5$, it is the Kelvin mode. For $\gamma = 8/5$, neither of the lowest modes reduces to either the radial mode or the Kelvin mode in the limit of small $\mathfrak{M}$. The results are examined in the limit of large γ (nearly incompressible fluid).

2843

Texas U. Dept. of Physics, Austin.

A FLOW-SYSTEM AND BURNER FOR OBSERVING SELECTIVE EXCITATION OF SPECTRA BY META-STABLE SPECIES IN THE AFTERGLOW OF A HELIUM DISCHARGE, by C. B. Collins and W. W. Robertson. [1963] [5]p. incl. diagr. (AFOSR-64-1677) (AF AFOSR-84-273) AD 448258   Unclassified

Also published in Spectrochim. Acta, v. 19: 747-751, 1963.

A flow-system and burner has been developed for producing helium metastable species in a discharge and observing their reactions with admixed gases in a chamber a chosen distance downstream, thereby providing a selective time delay between the production and destruction of the helium metastables. A method for picking out the metastable species responsible for a particular reaction has been developed and examples of its application are given for the admixed gases Ne, N_2 and O_2. (Contractor's abstract)

2844

Texas U. Dept. of Physics, Austin.

ATOMIC EMISSION OF THE HELIUM AFTERGLOW, by F. E. Niles and W. W. Robertson. [1964] [4]p. incl. diagrs. (AFOSR-65-0562) (AF AFOSR-84-273) AD 815189   Unclassified

Also published in Jour. Chem. Phys., v. 40: 3588-3571, June 15, 1984.

The spectral emission from a dc pulsed helium discharge for pressures from 5 to 20 Torr has been investigated during the early afterglow using interference filters with gated photomultiplier. The radiation transmitted by the filters consists generally of both atomic lines and molecular bands and after the termination of the active discharge shows characteristically an initial rapid decrease in intensity followed by a much slower rate. The rapid decrease is due to the atomic radiation, the slower to molecular. By subtracting the molecular emission from the total emission transmitted through an interference filter, the atomic emission is obtained.

2845

Texas U. Dept. of Physics, Austin.

SPATIAL DISTRIBUTION OF INTENSITY IN A HELIUM AFTERGLOW, by F. E. Niles and W. W. Robertson. [1984] [2]p. incl. diagr. (AFOSR-85-0563) (AF AFOSR-64-273) AD 816471   Unclassified

Also published in Jour. Chem. Phys., v. 41: 1523-1524, Sept. 1, 1984.

A graphical presentation is given for the change with time in the spatial distribution of intensity of radiation and thus of ion concentration in a cylindrical discharge cell with an extreme asymmetry in the initial distribution. It is shown that this molecular emission observed during the helium afterglow is the result of a volume process during the afterglow period. It is not the result of radiative processes occurring during neutralization of molecular ions at the wall.

2846

Texas U. [Dept. of Psychology] Austin.

ATTRACTION AS A FUNCTION OF ATTITUDE SIMILARITY-DISSIMILARITY: THE EFFECT OF TOPIC IMPORTANCE, by D. Byrne and D. Nelson. [1984] [2]p. (AFOSR-84-1301) (AF AFOSR-63-261) AD 444265   Unclassified

Also published in Psychonom. Sci., v. 1: 93-94, 1964.

The similarity-dissimilarity of a stranger's attitudes with respect to those of Ss and the importance of the attitudinal topics were experimentally varied, and the attraction response of 112 Ss obtained. Proportions of similar attitudes was found to have a highly significant effect on attraction, but neither topic importance nor the interaction was statistically significant.

2847

Texas U. [Dept. of Psychology] Austin.

THE REJECTION OF DEVIATES AS A FUNCTION OF THREAT, by E. J. Hall, Jr. Doctoral thesis, June 1963, 114p. (AFOSR-5348) (AF AFOSR-63-275) AD 421742   Unclassified

It was hypothesized that (a) Ss from two-man groups would be more rejecting of deviates than Ss from four-man groups; (b) high status deviates would be rejected more strongly than low status deviates; (c) high dogmatic Ss would be generally more rejecting of deviates than low dogmatic Ss; and (d) that high dogmatic Ss would be more accepting of high status deviates and more rejecting of low status deviates than would low dogmatic Ss. The results failed to confirm either the group size or dogmatism hypothesis, but lent significant support to the hypotheses concerning status of the deviate and the interaction of status and dogmatism effects.

2848

Texas U. [Dept. of Psychology] Austin.

AROUSAL, MANAGEMENT, AND REDUCTION OF HOSTILITY, by P. Worchel. Final rept. Aug. 31, 1964, 4p. (AFOSR-64-1960) (AF AFOSR-63-275)
                                   Unclassified

Studies undertaken under this contract include: (1) threat and hostility arousal and reduction; (2) the rejection of deviates as a function of threat; (3) reference group relationships and dogmatism as determinants of influence and interpersonal conflict; (4) authoritarianism and anxiety in middle eastern students residing in the United States; and (5) ideology and political behavior.

2849

Texas U. [Labs. for Electronics and Related Science Research] Austin.

QUANTUM ASPECTS OF ELECTRICAL SCIENCE, by A. A. Dougal. Final rept. Apr. 1-Sept. 30, 1984. Oct. 1, 1964, 91p. incl. illus. diagrs. tables, refs. (AFOSR-65-0248) (AF AFOSR-64-487) AD 811338
                                   Unclassified

An experimental and analytical study of the characteristics of coupled optical resonators is presented. The concept of an equivalent laser resonator is introduced and employed in an analysis of coupled resonator systems. Qualitative results from such an analysis agree with the experimental results presented. A dual wavelength beam switching phenomena involving coupled resonators is also reported. Experimental results are presented of a study of thermal pinching in germanium. Incremental negative resistance is observed in the thermal pinched condition. A comparison of the imaging properties of coherent laser light and white light is presented. (Contractor's abstract, modified)

2850

Texas U. Labs. for Electronics and Related Science Research, Austin.

CURRENT SHEATH DYNAMICS AND MAGNETOSONIC OSCILLATIONS IN MAGNETOPLASMAS, by O. M. Friedrich, Jr. and A. A. Dougal. Dec. 15, 1984, 128p. incl. refs. (Technical rept. no. 2) (AFOSR-86-0515) (AF AFOSR-85-766)   Unclassified

The electrical breakdown, current sheath formation, and acceleration of current sheaths in deuterium, hydrogen, and argon plasmas are investigated analytically and experimentally. A system of partial differential equations is written from the Maxwell's electromagnetic field equations and plasma equations to describe the current density, resistivity, electron temperature, ion temperature, and degree of ionization as functions of position and time. The plasma equations include: an energy balance equation, an equation relating resistivity to collisions, and ionization equation, and an energy transfer equation. The resulting set of partial differential equations is coded for electronic digital computation using finite difference techniques. Theoretical results are obtained for initial deuterium gas pressures of 1μ, 100μ, and 1 mm Hg.

2851

Texas U. [Labs. for Electronics and Related Science Research] Austin.

35-GC/S, 70-GC/S AND 94-GC/S CYTHEREAN RADIATION, by C. W. Tolbert and A. W. Straiton. [1964] [4]p. incl. diagrs. refs. (AFOSR-86-1056) (AF AFOSR-66-766) AD 643017   Unclassified

Also published in Nature, v. 204: 1242-1245, Dec. 1964.

Measurements of Cytherean radiation were conducted at frequencies of 35 Gc/s, 70 Gc/s and 94 Gc/s with a 16-ft diameter antenna. The 35-Gc/s measurements were made to associate the relative brightness temperature of the three frequencies to the brightness temperature of a frequency at which a number of measurements have been reported. While the three frequencies are too widely spaced to yield significant line spectra and even the bandwidth of the radiometer at each frequency is excessively wide for low-pressure gas line resolution, the absorption minima of the Earth's atmosphere at 35 Gc/s and 94 Gc/s make these frequencies attractive for Earth-based observations.

2852

Texas U. [Labs. for Electronics and Related Science Research] Austin.

IONOSPHERIC TRANSMISSION OF TRANSVERSELY PROPAGATED PLANE WAVES AT MICROPULSATION FREQUENCIES AND THEORETICAL POWER SPECTRUMS, by C. E. Prince, Jr., and F. X. Bostick, Jr. [1964] [22]p. incl. diagrs. tables, refs. (AFOSR-66-1070) (AF AFOSR-66-766)   Unclassified

Also published in Jour. Geophys. Research, v. 69: 3213-3234, Aug ' 1964.

From atter and phase constants for plane waves in a partly onized magnetoionic medium, the resultant surface magnetic field for discrete, constant-amplitude input signals at an outer boundary is calculated and is presented as power spectrums. The ionosphere is assumed to be stratified, and the only mode considered is the extraordinary mode, propagating at 90° with respect to the earth's magnetic field. The results are discussed with reference to experimental power spectrums. (Contractor's abstract)

2853

Texas U. Medical Branch. [Dept. of Pharmacology] Galveston.

POST GANGLIONIC CHOLINERGIC MEDIATION OF SYMPATHETIC NERVES, by J. G. Hilton. Annual rept. May 1, 1963-Apr. 30, 1964, 2p. (AFOSR-64-1649) (AF AFOSR-82-241) AD 605726 Unclassified

The question of a non-specific stimulation of ganglion as proposed by Levy and Ahlquist is considered and the differences between a non-specific stimulation and the restoration of blood pressure and return of carotid occlusion response are discussed in the paper. Two additional areas of ganglionic and cardiovascular function during the neostigmine pressor response have been studied during the period of this report. Area 1 is the study of pre- and post-ganglionic nerve potentials. Area 2 is a study of the peripheral vascular tone during the neostigmine pressor response.

2854

Texas U. Medical Branch. [Dept. of Pharmacology] Galveston.

THE EFFECTS OF NEOSTIGMINE UPON GANGLION RESPONSES AFTER ADMINISTRATION OF BLOCKING DRUGS, by P. A. Fenner and J. G. Hilton. [1963] [8]p. (AFOSR-64-1682) (AF AFOSR-63-391) AD 448259 Unclassified

Also published in Brit. Jour. Pharmacol. and Chemother., v. 21: 323-330, Oct. 1963.

The effects of block of autonomic ganglia by chlorisondamine and by hexamethonium, the administration of neostigmine and of atropine upon blood pressure, nervous transmission through the superior cervical ganglion, stimulation of autonomic ganglia by dimethylphenylpiperazinium, and the carotid occlusion reflex, have been studied in the dog anaesthetized with sodium pentobarbitone. The results of these studies have shown that (1) a ganglion blocking agent blocks synaptic transmission in the superior cervical ganglion at the same time as it lowers blood pressure and (2) if the effects of preganglionic nerve stimulation are recorded as a contraction of the nictitating membrane, a ganglion-blocking agent also abolishes this response at ' e

same time that it blocks the reflex rise in blood pressure produced by occlusion of both common carotid arteries.

2855

Texas U. Medical Branch. [Dept. of Pharmacology] Galveston.

EFFECT OF GANGLIONIC BLOCKADE UPON PERIPHERAL BLOOD PRESSURE DURING MAJOR VESSEL OCCLUSION (Abstract), by P. A. Fenner and J. G. Hilton. [1964] [1]p. (AFOSR-64-1842) (AF AFOSR-83-391) Unclassified

Also published in Federation Proc., v. 23: 330, 1964.

Cardiovascular effects of ganglionic blockade were studied in anesthetized dogs using a modification of the major vessel occlusion (MVO) method of Barteistone. Ganglionic blockade did not alter the pattern of response in either of the peripheral blood pressures in the abdominal series but did alter it in the thoracic series. In the abdominal-clamped group, the arterial pressure fell to levels not significantly lower after blockade. Rise in venous pressures during MVO was less after blockade than during control. In the thoracic-clamped series, arterial pressures fell during the entire MVO after ganglionic blockade but stabilized after 20 sec. in the control MVO. Venous pressures rose more rapidly and steadily during control than after ganglionic blockade. (Contractor's abstract, modified)

2858

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

STUDY OF A TRACER METHOD FOR SOLID PROPELLANTS, by D. Fleischer. Final rept. June 19, 1981-June 18, 1982. Feb. 1983, 43p. incl. illus. diagrs. tables. (RMD rept. no. 5502-F) (AFOSR-J1383) (AF 29(600)3020) AD 405479 Unclassified

A photometric method for determining local burning rates in solid propellant motors is described. Preliminary strand experiments are used to estimate burning rates of tracer and propellant under engine conditions. These values are introduced in an expression relating accuracy of photometric burning rate to tracer thickness, separation between tracer deposits, and tracer and propellant burning rates. Tracer thickness and separation in the test engine for a desired accuracy are thus defined. Engine burning rates reproducible to ± 7% for a one centimeter separation were easily obtained. (Contractor's abstract)

2857

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

INFLUENCE OF IONS ON ROCKET COMBUSTION, by

T. H. Dimmock. Final rept. Mar. 1, 1958-Mar. 21, 1963, 55p. incl. illus. diagrs. tables, refs. (AFOSR-5493) (AF 49(636)305) AD 431838   Unclassified

A study of the electrical and thermodynamic properties of a seeded, Mach 3 rocket exhaust at an equivalent altitude of 20-25 miles has been made. It was concluded that the ionization and dielectric profile of the jet depends upon many factors. Among these are: (1) The combustion process, including the injector type and stoichiometry; (2) The nozzle length and area ratio; and (3) The Mach number, and shock structure in the jet. These factors are interrelated in a complex manner so that extrapolation of results for dissimilar conditions is not allowed.

2858

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

IONIZATION PROFILES IN LOW PRESSURE EXHAUSTS, by T. H. Dimmock and W. R. Kineyko. Aug. 1963, 16p. (Rept. no. 83-388) (AFOSR-J1089) (AF 49(638)305) AD 421129   Unclassified

Presented at Fifth Biennial Gas Dynamics Symposium, Northwestern U., Evanston, Ill., Aug. 14-16, 1963.

The ionization profile along the axis of a seeded, Mach 3, high altitude rocket exhaust was mapped by microwave and probe techniques. The ionization density in the jet was as high as 10^{13} electrons/cm^3 and was found to vary half an order of magnitude between expansions and shock regions. The relaxation in the jet was evaluated from the measured data. Since the ionization was found to follow the gas density profile, it was concluded that the relaxation time is at least as long as the transit time between the shock waves, and that the residence time in the shock zone was sufficient to sustain this ionization. The thermodynamic properties in the jet were measured by pressure and temperature probes and by line reversal spectroscopy.

2859

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

THE LOW PRESSURE, COMBUSTION GAS PLASMA, by T. H. Dimmock and W. R. Kineyko. [1963] [9]p. incl. illus. diagrs. tables, refs. (AFOSR-J1477) (AF 49(838)305) AD 426823   Unclassified

Also published in Combustion and Flame, v. 7: 283-291, Sept. 1963.

Studies of the electrical properties of seeded, high-temperature, low pressure flames have been made to determine the influence of electric and magnetic fields on plasma properties and to evaluate plasma diagnostic techniques. The investigation was carried out at pressures from 20 to 100 mm of mercury where both magnetic and fluid viscosities influenced the flame electrical conductivity, and where the electric field produced abnormal glow and arc discharges. The deflection of

flames at low pressures was found to reach a limit when slippage of charged particles through the flame fanned out the flame rather than further deflecting it.

2860

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

THE GENERATION OF CHARGED COLLOIDS FOR ELECTRIC PROPULSION VIA HETEROGENEOUS CONDENSATION IN VACUUM OF METAL VAPORS ON A SURFACE, by B. Hornstein. Final rept. June 20, 1980-Dec. 19, 1963. Mar. 1964, 37p. incl. illus. diagrs. table, refs. (RMD rept. no. 2049-F) (AFOSR-85-0925) (AF 49(836)924) AD 817120   Unclassified

As an approach to the in situ generation of charged colloids for electric propulsion, a heterogeneous condensation method was investigated. The method comprised two distinct steps; first, the formation of neutral particles by the controlled vacuum deposition of metal vapor onto a solid substrate, and second, the inductive charging and electrostatic separation of the particles from the substrate by a strong electric field. Attempts to inductively charge and electrostatically separate such particles from carbon substrates were almost completely unsuccessful, as determined from electron microscope examination. Some experiments with a time-of-flight particle removal and detection system gave evidence that particles had been extracted from the substrate, acquiring charge-to-mass ratios up to 3000 coulombs/kg. If such particle charging and removal had in fact occurred, only a small fraction of the total deposit could have been involved. (Contractor's abstract, modified)

2661

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

SOLID PROPELLANT TRACING METHODS, by D. Fleischer. Semiannual scientific rept. Oct. 15, 1963-Mar. 14, 1964. Apr. 1964, 36p. (RMD rept. no. 5510-SA) (AFOSR-64-1954) (AF 49(836)1197) AD 807636   Unclassified

The investigation of the use of light absorption signals in motor exhausts for determining motor burning rates was terminated. It is concluded that erratic absorption and diffraction from solid particles and the shock structure in the exhaust prevent this method from yielding useful results. Work concerning the effects of trace species on the electron concentration in combustion gases was initiated. The systems of interest always contain low ionization potential impurities, whose concentration is affected by the formation of compounds stable at flame temperatures. The effect of sodium chloride formation on the concentration of trace amounts of sodium was measured. It has not yet been possible to provide a conclusive interpretation of this data based on either equilibrium or kinetic considerations.

2862

Thiokol Chemical Corp. Reaction Motors Div.,
Denville, N. J.

TRACE SPECIES IN COMBUSTION GASES, by D.
Fleischer. Final rept. Oct. 15, 1963-Oct. 14, 1964.
Nov. 1964, 36p. incl. diagrs. tables. (RMD rept. no.
5510-F) (AFOSR-65-1053) (AF 49(638)1197) AD 619492
Unclassified

The equilibrium constant for the reaction NaCl(g) +
$HBO_2(g) = NaBO_2(g) + HCl(g)$ is determined to be,

$K_p = 2.50$ (1980°K). Sodium vapor and boron trichloride

(BCl_3) are reacted in a hydrocarbon-air flame contained
in a tunnel burner. Conditions are such that the con-
centrations of HBO_2 and HCl are equal to the total flows
of boron and chlorine. The concentration of unreacted
sodium is found by line absorption, using an experi-
mentally determined absorption coefficient. The rela-
tive contribution of NaCl and $NaBO_2$ to the chemically
combined sodium concentration can be assessed by re-
moving the direct proportionality between chlorine and
boron flows. This is done by adding chlorine, beyond
that present in the BCl_3. The H-atom concentration is
also required, and is inferred from the intensity of the
$2\pi \rightarrow 2\Sigma$ (0, 0) OH-band. (Contractor's abstract)

2663

Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

RESEARCH IN SEMANTIC STRUCTURE, by P. L.
Garvin. Jan. 15, 1963, 22p. incl. tables. (AFOSR-
4944) (AF 49(638)1126) AD 296426 Unclassified

Presented at Thirty-seventh annual meeting Linguistic
Society of America, New York, Dec. 28-30, 1962.

The semantic classification revealed by predication-
typing does not coincide with the formal grammatical
division into word classes. Function words—such as
conjunctions and prepositions—when viewed in the light
of predication-typing turn out to have significant ele-
ments of meaning in common with content words—such
as certain verbs and nouns. An example of this is the
semantic spectra of the function word from and the con-
tent word result shown on the handout.

2664

Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

THE CONVERSION OF PHONETIC INTO ORTHOGRAPH-
IC ENGLISH: A MACHINE-TRANSLATION APPROACH
TO THE PROBLEM, by P. L. Garvin and E. C.
Trager. Nov. 1, 1963, 22p. incl. tables. (AFOSR-
64-1867) (AF 49(638)1166) AD 425819; AD 450100
Unclassified

Also published in Phonetica, v. 11: 1-18, 1964.

The conversion of phonetic into orthographic English

is treated as a special case of machine language trans-
lation. A technique of graduated context searching is
proposed. A pilot study is presented and its results
are evaluated.

2665

Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

SPEAKER IDENTIFICATION AND MESSAGE IDENTIFI-
CATION IN SPEECH RECOGNITION, by P. L. Garvin
and P. Ladefoged. [1963] [7]p. incl. refs. (AFOSR-
64-0233) (AF 49(638)1166) AD 432521 Unclassified

Also published in Phonetica, v. 9: 193-199, 1963.

This paper treats the problem of the identification of
speaker and message in the human and automatic recog-
nition of speech. It presents a classification of speaker-
diagnostic features and make some suggestions for
future research in the field.

2866

Toronto U. Dept. of Chemistry (Canada).

CHEMICAL REACTIONS IN ELECTRICAL DISCHARGES.
I. THE SPECTRUM OF THE METHANE-OXYGEN SYS-
TEM AT LOW PRESSURE IN THE POSITIVE COLUMN
OF A D-C GLOW DISCHARGE, by P. A. Bois d'Enghien
and J. M. Deckers. [1964] [19]p. incl. diagrs. refs.
(AFOSR-64-1863) (AF AFOSR-62-457) AD 449997
Unclassified

Also published in Canad. Jour. Chem., v. 42: 1792-
1810, 1964.

A technique is described which permits the study of
changes in the spectra emitted by fast flowing reacting
gas mixtures in the plasma of the positive column of a
weak d-c glow discharge. In certain cases a quantita-
tive relationship is shown to exist between the concen-
tration of a species and the intensity of emission of its
spectrum. In particular such a correlation exists be-
tween the emission intensity of CC and its concentra-
tion. Use of this fact is then made to follow the rate of
formation of carbon monoxide in methane-oxygen mix-
tures flowing through a discharge. The mechanism of
formation of the various emitters either by means of a
chemical reaction or by electron impact on molecules
or radicals is discussed. It is concluded that to ac-
count for the rate of formation of CO, at least in the
early stages of the presence of the gases in the dis-
charge, before the steady state concentration of atoms,
radicals, and molecules were approached, most of the
energy of the electrons is used in breaking chemical
bonds. (Contractor's abstract)

2667

Toronto U. Dept. of Chemistry (Canada).

DISTRIBUTION OF ENERGY IN THE PRODUCTS OF
REACTIONS UNDER FLAME AND RELATED

CONDITIONS, by J. M. Deckers. Oct. 1964 [42]p.
incl. diagrs. refs. (Scientific rept. no. 1) (AFOSR-
65-2723) (AF AFOSR-63-375) AD 628228
Unclassified

Subjects discussed in this report are: Measurement of
the electrical field in D.C. flow discharges through
oxygen, nitrogen and oxygen-nitrogen mixtures; Pro-
duction of O atoms in the discharge; Emission spectrum
of oxygen containing small amounts of carbon monox-
ide; and Influence of pressure burner size and compo-
sition upon the intensity of emission of hydrocarbon-
oxygen flames.

2868

Toronto U. Inst. for Aerospace Studies (Canada).

AN INVESTIGATION OF THE FATIGUE OF ALUMINUM
ALLOY DUE TO RANDOM LOADING, by S. R. Swanson.
Feb. 1963, 1v. (AFOSR-4921) (AF 49(838)548)
AD 407071   Unclassified

A study of the aluminum alloy 2024-T4 under random
and constant amplitude axial fatigue loading was under-
taken using 1500 unnotched extruded bar specimens.
In the constant amplitude test series, it was discovered
that the stress amplitude - endurance (S-N) relation is
well represented by two separate failure distributions
such that, as the stress amplitude is lowered, the one
distribution recedes while the other distribution be-
comes predominant. The knee of the S-N curve is then
considered as a transition from endurances predomi-
nantly of the one distribution to endurances predomi-
nantly of the other.

2869

Toronto U. Inst. for Aerospace Studies (Canada).

THE EFFICIENCY OF ENERGY TRANSFER ASSOCI-
ATED WITH MAGNETICALLY DRIVEN SHOCK WAVES
IN A TEE TUBE, by J. K. Dukowicz. Apr. 1963 [44]p.
incl. illus. diagrs. tables, refs. (UTIA technical note
no. 52) (AFOSR-2429) (AF 49(638)823) AD 407953
Unclassified

The energy disposal in a shock tube with magnetically
driven shock waves has been studied. The well known
T-tube apparatus was used in the experiment. A tech-
nique to measure the energy input has been developed
involving the simultaneous measurement of the current
and the voltage drop across the tube. Schlieren rotat-
ing drum camera photographs of the flow provided accu-
rate shock wave trajectories from which the energy con-
tained in the flow was deduced by the use of strong
blast wave theory. The efficiency of the T-tube obtained
in this way was found to be approximately 20% under a
variety of conditions. The use of a backstrap did not
change the efficiency but was found to roughly double the
amount of energy deposited in the T-tube. In the range
1 - 10 mm Hg, no effect of pressure was detected.

2870

Toronto U. Inst. for Aerospace Studies (Canada).

THEORETICAL INVESTIGATIONS OF THE DYNAM-
ICS OF BODIES ENTERING THE ATMOSPHERE, by B.
Etkin. Final technical rept. Feb. 1963, 3p. (AFOSR-
4553) (AF AFOSR-62-40) AD 815120   Unclassified

The research was part of a long term program of re-
search on flight dynamics of artificial satellites.
Topics discussed in this report are reentry flight
paths, satellite dynamics, and flight simulators.

2871

Toronto U. Inst. for Aerospace Studies (Canada).

TURBULENCE-INDUCED PANEL VIBRATION, by
M. Y. El Baroudi. Feb. 1964, 1v. (Rept. no. 98)
(AFOSR-84-0883) (AF AFOSR-62-267) AD 448045
Unclassified

Motivated by the problem of boundary-layer induced
panel noise, a detailed study has been made of the
transverse vibration of steel panels flush-mounted in
the wall of a turbulent flow duct. The characteristics
of the exciting pressure field at the wall and of the re-
sultant vibration of the sample panels were investi-
gated using statistical techniques. Relief charts of
the experimental two-point space-time correlation of
panel vibration versus longitudinal separation and time-
delay showed pronounced oblique ridges and valleys
discernable in a more random pattern. These are in-
terpreted as running waves.

2872

Toronto U. [Inst. for Aerospace Studies] (Canada).

DYNAMICS OF GRAVITY-ORIENTED ORBITING SYS-
TEMS WITH APPLICATION TO PASSIVE STABILIZA-
TION, by B. Etkin. [1964] [7]p. incl. diagrs. refs.
(AFOSR-84-2128) (AF AFOSR-82-40 and AF AFOSR-
63-222) AD 452027   Unclassified

Also published in AIAA Jour., v. 2: 1008-1014, June
1964.

A theoretical framework is presented for analyzing
the motion of a multibody satellite system in a gravity-
oriented orbiting reference frame. It consists essen-
tially of expressions for the forces and moments of the
body-force field on arbitrary bodies and of their util-
ization in Lagrange's equation to find the equations of
motion. It is then applied to the analysis of a specific
system designed for passive attitude stabilization. The
equations are linearized and separated into two groups
(longitudinal and lateral), and numerical solutions are
obtained. Damping to half-amplitude in times of the
order of 0.3 orbit is possible in either system sepa-
rately. For combined three-axis stabilization, some-
what longer times would result from inevitable com-
promises. The effect of solar radiation on the sys-
tem is briefly discussed. (Contractor's abstract)

2873

[Toronto U. Inst. for Aerospace Studies (Canada)]

AN EXPERIMENTAL INVESTIGATION OF TURBU-
LENCE EXCITED PANEL VIBRATION AND NOISE
(BOUNDARY-LAYER NOISE), by M. Y. El Baroudi,
G. R. Ludwig, and H. S. Ribner. Apr. 1963, 33p.
(AGARD rept. no. 465) (AFOSR-64-0590) (AF AFOSR-
63-223) AD 435911   Unclassified

Presented at AGARD Specialists' Meeting of the Mecha-
nism of Noise Generation in Turbulent Flow, Training
Center for Experimental Aerodynamics, Rhode-Saint-
Genese (Belgium), Apr. 1-5, 1963.

A study is made of the flexural motion and noise gen-
erated by 11 x 11 in. steel panels flush-mounted in the
wall of a turbulent flow channel. The mean square ex-
citing pressure fluctuations at the wall, its spectral
density, and two-point correlations of the pressure
were measured with the use of pinhole microphones.
The flexural response of sample panels was studied by
correlation techniques. The calculated relief plot of
correlation shows qualitative agreement with the ex-
perimental results.

2874

Toronto U. Inst. for Aerospace Studies (Canada).

ON SPECTRA AND DIRECTIVITY OF JET NOISE, by
H. S. Ribner. [1963] [3]p. incl. diagrs. refs.
(AFOSR-64-0911) (AF AFOSR-62-267 and AF AFOSR-
63-223) AD 439866   Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35:
614-616, Apr. 1963.

On the assumption of locally isotropic turbulence super-
posed on the mean jet flow, the broadly peaked noise
spectrum is derived in terms of a sum of two bell-
shaped spectra peaked an octave apart. The propor-
tions vary with direction θ from the jet axis, being
dominated by the "bass" spectrum at small angles and
the "treble" spectrum beyond, say 70°. This is ac-
complished by a factor $\sim \cos^4 \theta$ for the "bass" spectrum.
For small angles (e.g., 30°), points of the resultant
curve are amplified (vertical shift) by convection of the
eddies and "Doppler" shifted (less than the full amount)
in frequency. It is suggested that an increase in am-
plification toward the left may move the amplified peak
in that direction. (Contractor's abstract)

2875

Toronto U. [Inst. for Aerospace Studies] (Canada).

NONEQUILIBRIUM EXPANSION FLOW OF DISSOCI-
ATED OXYGEN AROUND A CORNER, by I. I. Glass
and A. Takano. June 1963, 1v. (UTIA rept. no. 91)
(AFOSR-5441) (AF AFOSR-63-365) AD 426849
                              Unclassified

A detailed study is presented of the nonequilibrium in-
viscid expansion flow of dissociated oxygen around a

corner. The nonlinear partial differential character-
istic equations were solved for a number of cases with
different free-stream conditions and wall deflection
angles. It was found that the flow produced by the cor-
ner consists of seven basic flow areas, some of which
are quite complex. The existence of a recombination
shock wave at the tail of the expansion wave has been
verified. The shock wave is quite weak but increases
in strength with larger wall deflection angles, for a
given wall angle the shock wave is strongest near the
corner and decays with increasing radial distance from
the corner.

2876

Toronto U. Inst. for Aerospace Studies (Canada).

NONEQUILIBRIUM EXPANSION FLOW OF IONIZED
ARGON AROUND A CORNER, by I. I. Glass and A.
Takano. Sept. 1963 [91]p. incl. diagrs. tables, refs.
(UTIAS rept. no. 95) (AFOSR-5446) (AF AFOSR-63-
365) AD 429222   Unclassified

A study is presented of nonequilibrium, inviscid expan-
sion flows of ionized argon around a corner. The cal-
culating procedure is based on the method of charac-
teristics. Numerical computations were performed on
a number of cases with different free-stream conditions
and wall angles. The overall flow pattern obtained was
found to be qualitatively similar to that of dissociating
oxygen. However, an important exception was the non-
existence of a de-excitation shock wave, which was
verified even up to large wall angles and even when us-
ing a small size of characteristic mesh. Quasi-simi-
larities of the variations of the flow quantities along the
wave head and along the wall surface also were found to
exist when their appropriately normalized values were
plotted as functions of relevant distances.

2877

Toronto U. Inst. for Aerospace Studies (Canada).

. A DIGITAL COMPUTER PROGRAM FOR CALCULAT-
ING NONEQUILIBRIUM EXPANSION FLOWS OF DIS-
SOCIATED OXYGEN AND IONIZED ARGON AROUND A
CORNER, by J. Galipeau and A. Takano. Aug. 1963
[64]p. incl. diagrs. tables. (UTIAS technical note no.
69) (AFOSR-64-0075) (AF AFOSR-63-365) AD 444622
                              Unclassified

A digital computer program is described that permits
calculations of nonequilibrium expansion flows of dis-
sociated oxygen and ionized argon around a corner.
The procedure of calculation is based on the numerical-
graphical method of characteristics. An overall flow
chart of the program is included to indicate clearly the
sequence of logical and arithmetic tasks which the pro-
gram performs. A listing of the program is also given
to reveal fully its sequence of commands and opera-
tions. The program is divided into five phases. The
first two phases designate the input data, which con-
tain the statement of the free-stream values and the
prescribed wall deflection angle as well as the control
of calculation and printing. In the subsequent phases
calculations are performed to derive the flow quantities.

2878

Toronto U. Inst. for Aerospace Studies (Canada).

LANGMUIR PROBE MEASUREMENTS IN THE STAG-
NATION POINT BOUNDARY LAYER OF A BLUNT-
NOSED BODY IN A SUPERSONIC PLASMA FLOW, by
A. A. Sonin. June 1963 [38]p. incl. illus. diagrs.
table, refs. (UTIA technical note no. 58) (AFOSR-
2430) (AF AFOSR-63-366) AD 419146
Unclassified

Langmuir probes were used to traverse the boundary
layer at the stagnation point of a blunt-nosed body in a
supersonic plasma stream, and the experimental pro-
files of electron number density compared to the pre-
dictions of theory. The agreement of experiment and
theory was shown to be fairly good, although the lack
of an accurate method of temperature measurement
prevented a conclusive comparison.

2879

Toronto U. Inst. for Aerospace Studies (Canada).

THE NOISE OF AIRCRAFT, by H. S. Ribner. Aug.
1964 [60]p. incl. diagrs. refs. (UTIAS rev. no. 24)
(AFOSR-64-1310) (AF AFOSR-64-223) AD 448043
Unclassified

Presented at General Lecture, Fourth Cong. Inter-
nat'l. Council of Aeronautical Sciences, Paris (France),
Aug. 24-28, 1964.

An understanding of the noise from jets, compressors,
boundary layers, and sonic booms is still developing.
In this lecture current concepts are presented, drawn
in part from recent theoretical and experimental re-
search. Where possible simple physical models of the
major features of the noise and vibration phenomena
are given. The noise from combustion and from pro-
pellers and rotors, being better known, is dealt with
more briefly. Some mention is made of acoustical
fatigue.

2880

Toronto U. Inst. for Aerospace Studies (Canada).

AERODYNAMICALLY GENERATED SOUND, by H. S.
Ribner. Final scientific rept. Dec. 1964 [56]p. incl.
diagrs. (AFOSR-65-1029) (AF AFOSR-64-223)
AD 620338   Unclassified

The research accomplishments of the project are sum-
marized. A study of surface motion in turbulence-
induced panel vibration demonstrated that panel motion
consists of running waves forced by the convected pres-
sure field superposed on a more irregular pattern.
Turbulent structure in the transition region, (4.5 to
8 diams downstream of the nozzle) of a 4-in. low-speed
jet was investigated with the aim of relating the turbu-
lence to the noise generating features of such a jet.
Progress has been made in improving the accuracy of
the hot-wire and time-delay correlator instrumenta-
tion, and timing, gate, and relay circuits were devel-

oped to semi-automate data processing. An aerofoil
probe for measuring the transverse component of
turbulence was also developed. Lastly, an anomaly in
the directivity pattern of jet noise was resolved.

2881

Toronto U. Inst. for Aerospace Studies (Canada).

THE MEASUREMENT OF ENERGY TRANSFER IN GAS-
SOLID SURFACE INTERACTIONS USING ELECTRON
BEAM EXCITED EMISSION OF LIGHT, by D. J.
Marsden. Nov. 1964 [73]p. incl. illus. diagrs. tables,
refs. (UTIAS rept. no. 101) (AFOSR-64-2482)
(AF AFOSR-64-276) AD 612017   Unclassified

A new approach is described to the measurement of
energy accommodation of a rarefied gas at a solid sur-
face. The rotational energy distribution and number
density of molecules can be determined. Measurements
can be interpreted to obtain values of energy accommo-
dation coefficients, both for the translational and rota-
tional degrees of freedom of the gas. Measurements
made with nitrogen showed that the translational and
rotational degrees of freedom both had an accommoda-
tion coefficient $\alpha = 0.85$, and that the rotational energy
distribution of the reflected molecules correspond to
that of gas in thermal equilibrium.

2882

Toronto U. Inst. for Aerospace Studies (Canada).

ANALOGUE NETWORKS FOR HIGH HEAT-TRANSFER
RATE MEASUREMENTS, by Z. A. Walenta. Nov. 1964
[50]p. incl. illus. diagrs. refs. (UTIAS technical note
no. 84) (AFOSR-65-0261) (AF AFOSR-64-365)
AD 462023   Unclassified

An automatic correction circuit for use with thin-film
heat-transfer gauges and analog networks has been de-
veloped and successfully tested. Such a correction cir-
cuit is essential when the gauge temperature becomes
high enough to cause changes in the gauge properties,
thereby introducing nonlinear effects. The circuit has
been tested in the UTIAS 4 in. x 7 in. hypersonic shock
tube at shock Mach numbers where ionization was negli-
gible. Excellent agreement has been obtained between
theory and the corrected experimental data up to rises
in gauge temperatures of 75°C. It is expected that the
same results will hold up to 150°C, as long as the
thermal diffusivity of the backing material remains sen-
sibly constant. In addition, useful theoretical correc-
tions have also been obtained.

2883

Toulouse U. (France).

EFFECTS OF HEART DISTENSION ON ALDOSTERONE
SECRETION, by A. Baisset, L. Douste-Blazy, and P.
Montastruc. Final technical rept. Apr. 1, 1960-
Mar. 30, 1963, 13p. incl. diagrs. (AFOSR-J1205)
(AF 61(052)411) AD 424242   Unclassified

The effects of auricular distension have been studied on the secretion of aldosterone in the intact dog as well as after vagotomy, decerebration, hypophysectomy, or hypothalamic lesions. In the anesthetized dog it was found that: (1) Distension of the right auricle diminishes aldosterone secretion by at least 50%; this effect is suppressed by vagotomy or posterior hypothalamic lesions; in contrast, hypophysectomy or anterior hypothalamic lesions do not alter this decrease of aldosterone secretion; and (2) distension of the left auricle does not influence aldosterone secretion.

2884

Trieste U. Mathematical Inst. (Italy).

ANALYTICAL PROBLEMS CONCERNING THE EQUATIONS OF NAVIER-STOKES, by G. Prodi. Final technical rept. [Feb. 1964] 12p. (AFOSR-64-0153) (AF EOAR-62-7)   Unclassified

This report is a compilation containing the summaries of four papers prepared under this contract.

2885

Trieste U. Mathematical Inst. (Italy).

[AN APPLICATION OF THE THEORY OF ANY SINGLE INTEGRAL TO THE STUDY OF LINEAR DIFFERENTIAL EQUATIONS OF THE FIRST ORDER] Un'applicazione della teoria degli integrali singolari allo studio delle equazioni differenziali lineari astratte del primo ordine, by L. de Simon. [1964] [19]p. (AFOSR-65-2436) (AF EOAR-62-1) AD 627769   Unclassified

Also published in Rend. Sem. Matem. Univ. Padova, v. 34: 205-223, 1964.

This work is concerned with the p-integrability of the derivative of the solution, u(t), of the abstract Cauchy

problem $\frac{du}{dt} + Au = f(t)$, $t \geq 0$ $u(0) = 0$ where f(t) is a

function of the real variable t, defined for $t \geq 0$, having values in Hilbert space H, and A is a linear operator in H.

2886

Tufts U. Inst. for Psychological Research, Medford, Mass.

THE EFFECTS OF DISPLACED EARS ON AUDITORY LOCALIZATION, by S. J. Freedman and K. Stampfer. Apr. 1964, 24p. incl. illus. diagrs. tables, refs. (AFOSR-64-0938) (AF 49(638)1282) AD 604569
                            Unclassified

The techniques of rearrangement and disarrangement were used to alter the normal relationship between an observer and his auditory or visual environment. In general, rearrangement leads to orderly adaptation of perceptual-motor performance, while disarrangement leads to degradation of performance. This experiment

was an auditory rearrangement. 2 of the 4 experimental subjects demonstrated significant shifts averaging 6 degrees in their judgments of auditory direction. The shifts in localization are discussed in terms of the nature of the exposure situation and the factors that are likely to be responsible for compensation.

2887

Tufts U. Inst. for Psychological Research, Medford, Mass.

ADAPTATION AND TRAINING EFFECTS IN ERG. IV. OVERVIEW OF EIGHT YEARS, by S. J. Freedman and L. Ronchi. [1964] [24]p. incl. diagrs. refs. (AFOSR-65-1309) (AF 49(638)1282) AD 620726
                            Unclassified

Also published in Atti Fondazione G. Ronchi, v. 19: 542-565, Sept.-Oct. 1964.

A summary is given of eight years of investigation of electroretinograms (ERG). Experimental results lend support to the conclusion that the ERG responses recorded in any particular experimental session are significantly affected by previous experience of the subject. It is indicated that ERG is not an objective, stable measure of visual function. Neither the absolute level of response to a fixed stimulus intensity nor the acuity of discrimination was constant for the observers tested. It is concluded that some kind of learning must be involved in ERG responses. A statistical treatment of the evidence is presented.

2888

[Turin U. (Italy)]

[RESEARCH ON THE ASTRONOMICAL ORIENTATION OF EQUATORIAL LITTORAL AMPHIPODA. I. SOLAR ORIENTATION IN ONE SOMALIAN POPULATION OF TALORCHESTIA MARTENSII WEBER] Ricerche sull'orientamento astronomico di anfipodi litorali della zona equatoriale. I. L'orientamento solare in una popolazione somala di Talorchestia Martensii Weber, by A. Ercolini. [1964] [34]p. incl. diagrs. (AFOSR-65-0951) (AF EOAR-62-100) AD 620528   Unclassified

Also published in Zeitschr. Vergleich. Physiol., v. 49: 138-171, 1964.

In this note the solar orientation of Talorchestia martensii Weber is investigated. The mechanism of solar orientation shows particular time variations of its correctness, due to the local astronomic circumstances. Animals tested immediately after collection, after having been kept under a normal artificial rhythm of light-darkness, or kept segregated in continuous darkness, showed systematic differences from the correct orientation. The existence of an innate correct directional tendency is confirmed in littoral Amphipods. The behavior during the 2 periods of positive and negative solar declination is discussed and 3 hypotheses are offered in explanation.

2889

Turin U. [Inst. of Physics] (Italy).

ON THE GREEN'S FUNCTION OF POTENTIAL SCAT-
TERING, by M. Verde. [1963] [20]p. (AFOSR-J920)
(AF EOAR-62-101) AD 416508   Unclassified

Also published in Nuovo Cimento, Series X, v. 28:
547-566, 1963.

The Green's function in some potential scattering prob-
lems of spherical symmetry is written as an integral of
the product of the Green's functions G_a corresponding
to the angular variables and G_r corresponding to the
radial variables. The integration is carried along a
suitable line C in the plane of complex angular momen-
tum. If C surrounds the spectrum of G_a the usual par-
tial waves expansion is obtained, if C surrounds the
spectrum of G_r a different expansion results which is
the most suitable for describing collisions involving
small wave lengths. In particular it is shown how the
Green's function which characterizes a wave propaga-
tion phenomenon approaches the classical limit, lead-
ing to the ray propagation of ordinary mechanics.

2890

Turin U. Inst. of Physics (Italy).

ON THE CONNECTION BETWEEN S-MATRIX AND
THE NEUMANN SERIES EXPANSION OF THE WAVE
FUNCTION, by L. Favella. [1964] [14]p. incl. diagrs.
refs. (AFOSR-64-2053) (AF EOAR-62-101) AD 452522
                                       Unclassified

Also published in Nuovo Cimento, Series X, v. 31:
890-903, Feb. 16, 1964.

It is proved that the S-matrix may be expressed as the
quotient of two series involving the coefficients a_n of
the Neumann series expansion of the wave function
$\varphi_v(x)$. This expansion is equivalent to writing the same
wave function as a Lebedev-Kontorovich transform
which provides through the differential equation a sys-
tem of linear algebraic equations in triangular form for
the coefficients a_n. (Contractor's abstract)

2891

Turin U. Inst. of Physics (Italy).

ANALYTICITY IN THE ANGULAR MOMENTUM IN
POTENTIAL SCATTERING, by V. De Alfaro, E.
Predazzi, and C. Rossetti. [1964] [14]p. incl. refs.
(AFOSR-64-2054) (AF EOAR-62-101) AD 452523
                                       Unclassified

Also published in Nuovo Cimento, Series X, v. 31:
42-55, Jan. 1, 1964.

A representation is given in the framework of potential
scattering for $\varphi(\lambda, k, x)$ and for the Jost function

displaying their analytic properties in the angular mo-
mentum variable under suitable conditions on the be-
havior of the interaction at small distances. A pertur-
bative form for the Regge trajectories is also given.
The Jost function is obtained as an expansion over mero-
morphic functions of the angular momentum variable.
(Contractor's abstract)

2892

Turin U. Inst. of Physics (Italy).

ON THE GREEN'S FUNCTIONS ASSOCIATED TO THE
WIGNER'S LITTLE GROUP, by A. Giovannini and M.
Verde. [1964] [8]p. (AFOSR-65-1352) (AF EOAR-62-
101 and AF EOAR-64-39) AD 622914   Unclassified

Also published in Nuovo Cimento, Series X, v. 34:
1306-1313, Dec. 1, 1964.

The irreducible unitary representations of the Wigner's
little group, excluding the homogeneous Lorentz group
in 4 dimensions, are investigated by the method of
Green's functions. The possible different classes of
the Wigner's little group are the 3-dimensional rotation
group R_3, the 3-dimensional Lorentz group L_3, and the
2-dimensional Euclidean group E_2. Inspection of the
different irreducible unitary transformations for these
classes generated by Green's functions reveals how they
are related to each other.

2893

Turin U. Inst. of Physics (Italy).

ON THE PROPERTIES OF LANDAU CURVES, by T.
Regge and C. Barucchi. [1964] [35]p. incl. diagrs.
table. (AFOSR-65-1353) (AF EOAR-62-101)
AD 622668   Unclassified

Also published in Nuovo Cimento, Series X, v. 34:
106-140, Oct. 1, 1964.

A derivation of several properties of Landau curves is
carried out with the methods of algebraic geometry. In
particular, formulas are established for the Plücker
characteristics of large classes of Landau curves. A
determinantal formalism by Cayley is shown to be par-
ticularly useful in connection with the present theory.

2894

Turin U. Inst. of Physics (Italy).

BOUND STATES AND RENORMALIZATION PROPER-
TIES, by L. Bertocchi, S. Fubini, and G. Furlan.
[1964] [12]p. incl. diagrs. refs. (AFOSR-66-1714)
(AF EOAR-64-39) AD 638075   Unclassified

Also published in Nuovo Cimento, Series X, v. 32:
745-756, May 1, 1964.

This paper discusses both in potential scattering and in
quantum field theory, the connection between the bound

state problem and the renormalizability of the theory. In particular, it is shown that a meaning can be given to the bound-state condition both in the framework of perturbation theory, and also if all the terms of the series are cut-off-dependent.

2895

Turin U. Inst. of Physics (Italy).

ANALYTICITY IN THE ANGULAR MOMENTUM FOR SINGULAR POTENTIALS, by M. Giffon and E. Predazzi. [1964] [17]p. incl. refs. (AFOSR-66-1718) (AF EOAR-64-39) AD 639547   Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1374-1390, Sept. 1, 1964.

The analytic properties in the angular momentum variable of the Jost functions and of the partial-wave S-matrix elements are investigated for a large class of repulsive potentials behaving near the origin as arbitrary inverse powers of the radial variable dominating over the centrifugal term. The asymptotic behavior of the Jost function for large angular momenta is obtained by means of a W.K.B. analysis and the implications of the asymptotic distribution of poles in the lambda plane on the possibility of writing a Mandelstam representation are also briefly discussed.

2896

Turin U. Inst. of Physics (Italy).

ELECTROPRODUCTION AT THE LIMIT OF VERY HIGH ENERGIES, by M. Lacombe and E. Predazzi. [1964] [6]p. incl. diagr. table. (AFOSR-66-1720) (AF EOAR-64-39) AD 639548   Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1466-1471, Sept. 1, 1964.

The process $e + N \to e' + N' + A$ is related to $\gamma + N \to N' + A$ and the latter is calculated in a peripheral model. Detailed numerical results are quoted.

2897

Turin U. Inst. of Physics (Italy).

ON THE GENERALIZATION OF THE OKUBO IDENTITY FOR SU_n, by F. Gliozzi. [1964] [3]p. (AFOSR-66-1724) (AF EOAR-64-39) AD 639544   Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1813-1815, Dec. 16, 1964.

It has been proved that the Gell-Mann-Okubo mass formula is a direct consequence of the Okubo identity. The aim of this paper is to show how to explicitly construct the analogous identities for any SU_n group.

2898

United Aircraft Corp. Research Labs., East Hartford, Conn.

ABSCISSAS AND WEIGHT COEFFICIENTS FOR LO-BATTO QUADRATURE, by H. H. Michels. [1963] [8]p. incl. tables. (AFOSR-J1476) (AF 49(638)1133) AD 427565 Unclassified

Also published in Math. Comput., v. 17: 237-244, July 1963.

Abscissas and weights for Lobatto quadrature are presented in tabular form for order n = 3(1)16, 24, 32, 40, 46, 64, 60, 96. All computations were performed on an IBM 7090 digital computer using extended precision routines. The tolerance for iteration on the roots was set at 1 x 10^{-22}. Several hand calculations of the roots and weight coefficients were performed. Complete agreement with the machine results was found in all cases to 21 decimals.

2899

United Aircraft Corp. [Research Labs.] East Hartford, Conn.

PROBE MEASUREMENTS IN A CESIUM PLASMA CONVERTER, by R. H. Bullis and W. J. Wiegand. [1963] [16]p. (Rept. no. P B38) (AFOSR-b141) (AF 49(636)-1221) AD 411474 Unclassified

Presented at Twenty-third annual conf. on Physical Electronics, Massachusetts Inst. of Tech., Cambridge, Mar. 22, 1963.

Measurements of the properties of the plasma in the interelectrode space of both conventional and arc mode thermionic converters were obtained with coaxial electrostatic probes. In the high-temperature cesium plasma present in the converter, it was found that severe distortion of the probe current-voltage characteristic occurs due to extraneous current leakage to the probe and thermionic emission from the probe tip. By means of techniques previously reported, these distortions were eliminated by employing a coaxial-type probe. A comparison of probe information is made to models of both types of converter.

2900

United Aircraft Corp. Research Labs., East Hartford, Conn.

PLASMA PROPERTIES IN A THERMIONIC CONVERTER, by R. H. Bullis and W. J. Wiegand. [1963] [10]p. incl. illus. diagrs. refs. (AFOSR-64-0898) (AF 49(636)1221) AD 600096 Unclassified

Presented at Twenty-fourth annual conf. on Physical Electronics, Massachusetts Inst. of Tech., Cambridge, Mar. 25-27, 1964.

The properties of the non-equilibrium plasma existing in the interelectrode space of the arc-mode converter were investigated with coaxial electrostatic Langmuir probes. Probe measurements were made as a function of cesium pressure, emitter temperature, interelectrode position and converter output in several low-temperature arc-mode converters. The plasma potential, was found to vary significantly across the interelectrode space. Both the existence of a retarding sheath for electrons very close to the emitter surface and a region farther from the emitter in which the variation in plasma potential is accelerating for electrons have been detected. Significant variations in the plasma potential existing in the space were observed with changes in emitter temperature, cesium pressure, and converter output.

2901

United Aircraft Corp. United Technology Center, Sunnyvale, Calif.

VAPOR-PHASE COMBUSTION OF BERYLLIUM AND ALUMINUM, by R. W. Hermsen and R. W. Woolfolk. Final rept. Dec. 1, 1962-Nov. 30, 1964. Dec. 31, 1964, 51p. incl. illus. diagrs. tables. refs. (Rept. no. UTC 2040-FR) (AFOSR-65-1056) (AF 49(638)1202) AD 617936 Unclassified

An experimental investigation of the vapor-phase combustion of aluminum and beryllium was undertaken using electrically vaporized wires as the source of high-temperature, high-pressure metal vapor. Specifically investigated were (1) the overall reaction rates for the conversion of metal vapor to condensed oxide; (2) the significant species which are present and may act as reaction intermediates; and (3) the detailed mechanism of the combustion including the nucleation and growth of condensed oxide particles.

2902

United Electrodynamics, Inc., Alexandria, Va.

SEISMOLOGICAL APPLICATIONS OF ORTHOGONAL FUNCTION EXPANSIONS, by P. W. Broome and W. C. Dean. Final rept. July 31, 1964, 1v. (AF 49-(636)1117) AD 443977 Unclassified

A method is presented to represent very complicated transients by only a few numbers rather than by curves or by the set of coordinate values necessary to draw the curves. The representation used is an expansion in terms of a set of orthonormalized exponential functions. Procedures necessary to generate these functions, find the expansion coefficients, and use these coefficients in further analysis are described in detail. Section II of the report is concerned with sets of continuous orthonormal functions and is oriented toward analog computation. Section III is devoted to developing sets of orthonormal sequences. These are orthonormal functions which are defined on the set of integers and are used for numerical calculations using sampled data.

2903

United Electrodynamics, Inc., Alexandria, Va.

TABLES OF ZEROS AND WEIGHT FACTORS FOR THE
ZERO ORDER LAGUERRE POLYNOMIALS FROM THE
3RD TO THE 100TH DEGREE AND THEIR APPLICA-
TION TO FOURIER - LAGUERRE TRANSFORMS, by
E. A. Flinn and W. C. Dean. Supplementary rept.
July 31, 1964, 1v. (AF 49(638)1117) AD 443976
Unclassified

Laguerre functions are more suitable for expansion of
aperiodic functions, non-vanishing only in positive
time, than periodic functions such as sines and co-
sines. The Fourier transforms of such transients can
be readily computed from the Laguerre expansions
since the Fourier transforms of the Laguerre functions
are known for all frequencies. Section I describes the
numerical methods suitable for machine computation
of both direct and inverse Fourier transforms from the
Laguerre expansions. Section II presents tables of the
zeros and weight factors for the zero order Laguerre
polynomials necessary for numerical expansion of
transients in Laguerre series.

2904

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry
(Sweden).

LOCALIZED RADIOLESIONS IN THE CENTRAL
NERVOUS SYSTEM, by T. Svedberg. Final technical
rept. Dec. 21, 1963, 3p. incl. refs. (AFOSR-64-
0022) (AF EOAR-62-84) Unclassified

Research performed during July 1962-Aug. 1963 on the
effect of high energy protons on the CNS is accounted
for by reference to published papers.

2905

Uppsala U. [Gustaf Werner Inst. for Nuclear Chemistry]
(Sweden).

RADIATION INDUCED "HYPOPHYSECTOMY" AND
HYPOTHALAMIC LESIONS IN LACTATING GOATS,
by C. C. Gale and B. Larsson. [1963] [20]p.
(AFOSR-64-0954) (AF EOAR-62-84) AD 439986
Unclassified

Also published in Acta Physiol. Scand., v. 59: 299-
318, 1963.

Radiolesions were produced in the pituitary gland
and/or median eminence-pituitary stald region of
seven lactating goats by use of a narrow, collimated
beam of 185 mev protons from a synchrocyclotron.
Radiation doses of 25 to 30 krad were restricted to
these structures by rotation of the goats' heads around
the vertical and horizontal axes of the planned lesion.
Ten to 15 days after pituitary irradiation in 4 goats,
milk production declined steeply over a 10-day period
to about 20% pre-lesion levels. In 2 of the hypophy-
sectomized animals with injury also in the median
eminence, diabetes insipidus developed concurrently

with the onset of lactation block. Daily replacement
with prolactin (luteotrophin), somatotrophin, ACTH,
triiodothyronine, and insulin had restored milk syn-
thesis to 60% of pre-radiation levels when destruction
trigeminal nerve trunks by continued lateral spread of
radiolesions caused by abrupt decline in the health of
the goats.

2906

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry
(Sweden).

RESPONSES OF NEONATAL RAT SPINAL CORDS TO
HIGH ENERGY PROTONS, by S. A. Gilmore. [1964]
[14]p. incl. illus. (AFOSR-64-185') (AF EOAR-62-
84) AD 450105 Unclassified

Also published in Acta Radiologica, v. 2: 81-94, Apr.
1964.

High energy protons directed through lumbar spinal
cords of rats 3 to 16 days old resulted in a high inci-
dence of neurologic abnormalities regardless of age at
time or irradiation. These changes are compared with
and discussed in relation to this investigators previous
work with roentgen irradiation. The histopathology of
these cords is described. Studies of spinal cords of
rats irradiated when 3 days old and killed 2 to 11 days
later showed a marked decrease in the quantity of
neuroglia and a consequent hypo- or amyelination.
These rather selective alterations are compared with
late, non-specific histopathologic changes in the cords
described above. (Contractor's abstract)

2907

Uppsala U. Inst. of Chemistry (Sweden).

RESEARCH ON PHASES CONTAINING TRANSITION
METALS AND NON-METALS, by G. Hägg. Final
technical rept. Jan. 1, 1958-Dec. 31, 1962. [1963]
[12]p. incl. refs. (AFOSR-4713) (AF 61(052)40)
AD 407711 Unclassified

This report deals with accurate determinations of basic
properties of phases in systems of transition metals
and non-metals. These studies are mainly confined to
the borides, silicides and phosphides of transition
metals from Groups VI, VII and VIII. Comprehensive
and detailed reviews of the binary transition metal bor-
ides, silicides and phosphides have been given. The
present report is therefore confined to general aspects
only, which are presented in two main paragraphs:
'Phase analyses' and 'Crystal chemistry.' Some
further comments are made on very recent results not
included above.

2908

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF $2HgCl_2 \cdot (C_2H_5)_2S$, by

C. -L. Branden. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-64-1552) (AF 61(052)43) AD 446112
Unclassified

Also published in Arkiv Kemi, v. 22: 83-91, 1964.

A considerable number of compounds formed between mercuric chloride and alkyl-sulphides have been isolated with widely different mole ratios of $HgCl_2$:sulphide. Thus in the system $HgCl_2$-$(C_2H_5)_2S$ two compounds, $HgCl_2 \cdot (C_2H_5)_2S$ and $2HgCl_2 \cdot (C_2H_5)_2S$, have been identified. The latter compound has been studied by infrared spectroscopy and a crystal structure determination has now been undertaken as part of an investigation into compounds formed between $HgCl_2$ and oxygen or sulphur donor molecules. (Contractor's abstract)

2909

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF $HgCl_2 \cdot 2(C_6H_5)_3AsO$, by C. -L. Branden. [1963] [12]p. incl. diagrs. tables, refs. (AFOSR-64-1553) (AF 61(052)43) AD 446113
Unclassified

Also published in Acta Chem. Scand., v. 17: 1363-1374, 1963.

The crystal structure of $HgCl_2 \cdot 2(C_6H_5)_3AsO$ has been determined and refined from three-dimensional x-ray data. The crystals are monoclinic (space-group $P 2_1/c$) with four molecules in a unit cell with the dimensions a = 16.40 A, b = 10.56 A, c = 16.23 A and β = 106.0°. The structure comprises discrete $HgCl_2 \cdot 2(C_6H_5)_3AsO$ molecules with a highly distorted tetrahedral configuration around the mercury atom. The mean bond-lengths are: Hg—Cl = 2.33 A, Hg—O = 2.35 A, As—O = 1.69 A, As—C = 1.93 A and C—C = 1.40 A. The bond angles subtended at the mercury atom are: Cl—Hg—Cl = 146.5°, Cl—Hg—O = 101.5° (mean value) and O—Hg—O = 92.5°. The bond angle subtended at the oxygen atom is 135.5° (mean value). The two crystallographically different $(C_6H_5)_3AsO$-groups of the molecule exhibit small deviations from three-fold rotation symmetry around the As-O vector, the deviations being different in the two groups. (Contractor's abstract)

2910

Uppsala U. [Inst. of Physics] (Sweden).

HIGH PRECISION NUCLEAR PROPERTIES STUDIES, by K. Siegbahn. Final technical rep'. Mar. 30, 1963, 1v. (AFOSR-4867) (AF EOAR-62-72) AD 414916
Unclassified

The following topics are discussed: Techniques and equipment used in high precision nuclear property studies: Iron-free double focusing, iron yoke double focusing, neutron capture, electron-electron coincidence,

universal coincidence, and electron-gamma coincidence spectrometers; Gamma-gamma angular and differential angular correlations; and Atomic beam magnetic resonance.

2911

Uppsala U. Inst. of Physics (Sweden).

IMPROVED EXPERIMENTAL METHODS FOR MEASUREMENTS OF NUCLEAR LIFETIMES DOWN TO 10^{11} SECONDS, by J. Lindskog and T. Sundstrom. [1963] [22]p. incl. diagrs. refs. (AFOSR-J495) (AF EOAR-62-123) AD 407857
Unclassified

Also published in Arkiv Fysik, v. 24: 199-220, 1963.

Improved methods for delayed coincidence measurements of nuclear lifetimes down to 10 ps have been developed. It is shown that when an electron coincidence spectrometer is used for the energy selection the measurements can in many cases be performed in such a way that the energy dependent instrumental time delays do not contribute to the measured lifetime. In addition these instrumental time delays have been carefully investigated.

2912

Uppsala U. [Inst. of Physics] (Sweden).

DETERMINATION OF THE ELECTROMAGNETIC TRANSITION PROBABILITIES IN THE GROUND STATE DECAY OF Au 199, by J. Lindskog, T. Sundstrom and others. [1963] [9]p. (AFOSR-J496) (AF EOAR-62-123) AD 407656
Unclassified

Also published in Arkiv Fysik, v. 24: 161-169, 1963.

The lifetimes of the two levels in Hg 199 which are fed from Au 199 have been measured by the delayed coincidence technique. The result is: 158 kev level: $T1/2 = (2.42 \pm 0.15)$ ns. 208 kev level: $T1/2 = (66 \pm 6)$ ps. The decay of Au 199 is discussed in terms of the core excitation model. The result of the present measurements is found to be consistent with the predictions of this model.

2913

Uppsala U. Inst. of Physics (Sweden).

A 50-CM DOUBLE FOCUSING BETA SPECTROMETER OF THE CURRENT SHEET TYPE, by K. Siegbahn, C. Nordling and others. [1964] [17]p. inci. illus. diagrs. tables, refs. (AFOSR-64-1008) (AF EOAR-62-123) AD 440986
Unclassified

Also published in Nuclear Instr. and Methods, v. 27: 173-189, May 1964.

A precision beta spectrometer is described. It is an air-cored, double focusing, instrument in which the magnetic field is generated by two coaxial cylindrical coils. Easy access is provided to the source and

detector positions and there is sufficient space for electron-gamma coincidence arrangements. The solid angle accepted by the spectrometer is 0.3% of 4π at a resolution of 0.2, and 0.05% at a resolution of 0.02%. Current regulation and data recording are completely automatic as well as the cooling system for the spectrometer coils. The maximum electron energy of the instrument is 3.5 mev.

2914

Uppsala U. Inst. of Physics (Sweden).

THE LIFETIME OF THE 420 KEV STATE IN Cd^{111}, by P. Sparrman, T. Sundstrom, and J. O. Lindstrom. [1964] [6]p. (AFOSR-64-1009) (AF EOAR-62-123) AD 441054   Unclassified

Also published in Arkiv Fysik, v. 26: 479-484, 1964.

The lifetime of the 420 kev state in Cd^{111} has been measured with the delayed coincidence technique. The electromagnetic transition rates for the 173 kev transition are discussed and compared with the transition rates for a few other transitions in Cd^{111}.

2915

Uppsala U. [Inst. of Physics] (Sweden).

A MEASUREMENT OF THE LIFETIME OF THE 138.9 KEV LEVEL IN Tm^{169}, by T. Sundstrom, P. Sparrman and others. [1964] [5]p. (AFOSR-64-1010) (AF EOAR-62-123) AD 441055   Unclassified

Also published in Arkiv Fysik, v. 26: 377-381, 1964.

The lifetime of the 138.9 kev 7/2+ level in Tm^{169} has been measured by the delayed coincidence technique. The result is T 1/2 = (321 ± 14) ps.

2916

Uppsala U. [Inst. of Physics] (Sweden).

TWO LIFETIMES IN THE GROUND STATE ROTA-TIONAL BAND OF Tm^{171}, by T. Sundstrom, J. O. Linstrom and others. [1964] [9]p. (AFOSR-64-1011) (AF EOAR-62-123) AD 441057   Unclassified

Also published in Arkiv Fysik, v. 26: 397-405, 1964.

The lifetimes of two states in the ground state rotational band of Tm^{171} have been measured with the delayed coincidence method. The results are compared with the corresponding data for the very similar rotational states in Tm^{169} and discussed with regard to the unified nuclear model.

2917

Uppsala U. [Inst. of Physics] (Sweden).

THE ELECTROMAGNETIC PROPERTIES OF LEVELS

AND TRANSITIONS IN THE GROUND STATE ROTA-TIONAL BAND OF Tm^{169}, by T. Sundstrom, J. Lindskog and others. [1964] [16]p. (AFOSR-64-1012) (AF EOAR-62-123) AD 441056   Unclassified

Also published in Arkiv Fysik, v. 26. 361-376, 1964.

The experimental data for the electromagnetic properties of the ground state rotational band of Tm^{169} are reviewed and discussed in terms of the unified nuclear model.

2918

Uppsala U. [Inst. of Physics] (Sweden).

PARALLEL FIELD MAGNETOACOUSTIC EFFECT IN ANTIMONY, by O. Beckman, L. Eriksson, and S. Hornfeidt. [1964] [2]p. (AFOSR-64-1222) (AF EOAR-63-53) AD 442850   Unclassified

Also published in Solid State Commun., v. 2: 7-8, 1964.

Oscillations in the acoustic attenuation in antimony are measured with longitudinal sound waves and magnetic field parallel to the 3-fold axis. The result is interpreted as oscillations in the field direction of electrons belonging to extremum orbits of the tilted Shoebert ellipsoids.

2919

Uppsala U. [Inst. of Physics] (Sweden).

DISLOCATION RELAXATION IN ALUMINUM, by M. Mongy, K. Salama, and O. Beckman. [1963] [3]p. (AFOSR-64-1223) (AF EOAR-63-53) AD 442851
                                   Unclassified

Also published in Solid State Commun., v. 1: 234-236, 1963.

Dislocation motions in the three principal planes of single aluminum have been studied at ultrasonic frequencies of 10, 20 and 50 mc/sec. The activation energies and the relaxation frequencies, calculated from the position of the Bordoni peak, show a high degree of anisotropy. The results are discussed in connection with Seeger's theory.

2920

Uppsala U. Inst. of Physics (Sweden).

ELASTIC CONSTANTS OF ALUMINUM, by J. Vallin, M. Mongy and others. [1964] [2]p. incl. tables. (AFOSR-64-2121) (AF EOAR-63-53) AD 451565
                                   Unclassified

Also published in Jour. Appl. Phys., v. 35: 1825-1826, June 1964.

The adiabatic elastic constants of aluminum have been measured with an ultrasonic pulse technique at liquid-helium, liquid-nitrogen, and room temperatures. The

values of the elastic constants at 4°K are calculated. The Debye characteristic temperature calculated from the figures is 425°K, in good agreement with the value obtained for specific heat data. The shear elastic constants are discussed with reference to the theory given by Leigh.

2921

Uppsala U. Inst. of Physics (Sweden).

ELASTIC CONSTANTS OF CsBr AND CsI FROM 4.2°K TO ROOM TEMPERATURE, by J. Vallin, O. Beckman, and K. Salama. [1964] [2]p. incl. tables, refs. (AFOSR-64-2351) (AF EOAR-63-53) AD 451937
Unclassified

Also published in Jour. Appl. Phys., v. 35: 1222-1223, Apr. 1964.

The elastic constants of pure single crystals of CsBr and CsI have been measured at liquid-helium, liquid-nitrogen, and room temperatures. The elastic constants give the Debye temperature 148.8°K for CsBr and 125.6°K for CsI. The infrared resonance frequencies calculated from compressibility data are in agreement with those obtained from infrared spectroscopy.

2922

Uppsala U. Inst. of Physics (Sweden).

STUDY OF THE BORDONI PEAK IN SINGLE-CRYSTAL AND POLYCRYSTALLINE COPPER, by M. Mongy, K. Salama, and O. Beckman. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0746) (AF EOAR-63-53) AD 615065   Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 859-877, Nov. 16, 1964.

The Bordoni peak has been investigated in single-crystal and polycrystalline copper by measuring the longitudinal ultrasonic absorption at 10, 20 and 50 mhz, in the temperature range 80° to 300°K. In the single-crystal sample, the measurements have been made in the 3 principal directions [111], [100] and [110]. The values of the activation energy W and the relaxation frequency f_0, calculated from the frequency-dependence of the peak on the temperature scale, show a high degree of anisotropy. The comparison of the shape of the peak with Zener's single relaxation theory shows that the peak in the [111] direction is due to a single relaxation process. In the polycrystalline sample and in the other 2 directions of the single-crystal specimen, the results favor a spectrum of different relaxation frequencies with a constant activation energy. The spectrum width factor γ differs from one case to the other, but γW has approximately the same value which equals the energy obtained in the [111] direction. (Contractor's abstract)

2923

Uppsala U. Inst. of Physics (Sweden).

DOPING STUDIES OF $Bi_2(Te, Se)_3$ ALLOYS, by O. Beckman, P. Bergvall, and K. Tripathi. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0747) (AF EOAR-63-53) AD 615066   Unclassified

Also published in Arkiv Fysik, v. 28: 215-221, Dec. 28, 1964.

Alloys of $Bi_2Te_3 - {}_x Se_x$ ($0 \le x \le 1$) doped with controlled amounts of Cu, CuBr and BiI_3 have been prepared according to the Bridgeman technique. The number ϵ, of charge carriers per doping molecule as obtained from thermoelectric and galvanomagnetic measurements is found to vary with the selenium substitution. The results are explained in terms of the chemical bonding in the Bi_2Te_3 lattice.

2924

Uppsala U. [Inst. of Physiology] (Sweden).

RESEARCH ON THE GENESIS OF ACTION POTENTIAL IN EXCITABLE TISSUES, by T. Teorell. Apr. 1, 1963, 25p. (AFOSR-4848) (AF 61(052)363) AD 414084
Unclassified

This report deals with a biophysical formalism applicable to various phenomena of excitability as exposed by living tissues like the nerve axons etc. A quantitative excitability analog was presented in terms of voltage (E), current (I), and a P-factor, located in a membrane containing fixed ionic groups. A physical realization of this formalism has been achieved in membrane experiments where electro-endosmosis plays an essential part (i.e., the membrane oscillator). In such systems the P-factor is identified as a hydrostatic pressure gradient, which is voltage dependent. However, in other systems the P-factor may be equivalent to any other variable that is correspondingly dependent on the electrical variables E and/or I. Examples are presented with references to corresponding physiological observations on nerves and other excitable objects, in particular Nitella cells.

2925

Uppsala U. [Inst. of Physiology] (Sweden).

RESEARCH ON THE GENESIS OF ACTION POTENTIAL IN EXCITABLE TISSUES, by T. Teorell. Final technical rept. Apr. 13, 1964, 44p. (AFOSR-64-0988) (AF EOAR-63-5) AD 600343   Unclassified

This report summarizes the research on the following: (1) Stable and unstable convection phenomena in a fixed charge membrane barrier, (2) Ion fluxes in the membrane oscillator, (3) The electrohydraulic excitability analog applied to presso-receptor problems, and (4) Research on ion selectivity in an artificial system.

2926

Uppsala U. Inst. of Physiology (Sweden).

THE ION FLUX ACROSS MEMBRANES DURING ELEC-
TRO-DIFFUSION AND CONVECTION, by T. Teorell.
[1964] [2]p. (AFOSR-65-1552) (AF EOAR-64-33)
AD 623372   Unclassified

Also published in Acta Physiol. Scand., v. 62: 293-294,
1964.

Ion flux is considered across a membrane containing
wide pores and separating 2 concentrations of a single
salt. A formula for cation flux is derived for electro-
diffusion and convection in the cases where forces
present are due to (1) the concentration gradient, (2)
the transmembrane potential gradient, and (3) the lin-
ear bulk flow velocity (V) through the membrane pores.
The formula is valid whether the water streaming V is
induced by a hydrostatic or an electro-osmotic pressure
difference across the membrane.

2927

Utah State U. Dept. of Chemistry, Logan.

PYROLYSIS STUDIES. VIII. POLAR SUBSTITUENT
EFFECTS IN THE VAPOR PHASE THERMAL DECOM-
POSITION OF ISOPROPYL BENZOATES, by G. G.
Smith and D. A. K. Jones. [1963] [4]p. incl. diagrs.
table, refs. (AFOSR-64-0217) (AF AFOSR-62-268)
AD 432506   Unclassified

Also published in Jour. Organic Chem., v. 26: 3496-
3499, 1963.

The absolute reaction rates of thermal decomposition
of a series of meta- and para-substituted isopropyl
benzoates have been measured in the vapor phase, us-
ing a new pyrolysis apparatus in which the pressure
changes were monitored continuously and automatical-
ly. The physical properties of eleven new substituted
isopropyl benzoates are reported.

2928

Utah State U. [Dept. of Chemistry] Logan.

THE EFFECT OF STRUCTURAL CHANGES ON THE
PYROLYSIS OF ORGANIC ESTERS, by G. G. Smith.
Final rept. Oct. 1964, 6p. (AFOSR-64-2343)
(AF AFOSR-62-266) AD 606632   Unclassified

A brief summary is given of systematic studies concern-
ing linear free energy relationships in solvent free
systems where the reaction rates are influenced by
substituents. A bibliography of the 14 published papers
generated under the contract is included.

2929

Utah State U. Dept. of Chemistry, Logan.

PYROLYSIS STUDIES. XI. POLAR EFFECTS OF

ORTHO SUBSTITUENTS, by D. A. K. Jones and G. G.
Smith. [1964] [3]p. incl. tables, refs. (AFOSR-65-
0535) (AF AFOSR-62-266) AD 617565   Unclassified

Also published in Jour. Org. Chem., v. 29: 3531-3533,
Dec. 1964.

Polar σ^0 substituent constants for several substituents
have been determined from rate data for vapor phase
elimination reactions in which resonance effects are
eliminated and proximity effects are minimal. These
σ_0^0-values agree fairly well with Taft's σ^*-values, and
with σ_0^0-values obtained from other literature data. A
table of values is given. (Contractor's abstract)

2930

Utah State U. Dept. of Chemistry, Logan.

PYROLYSIS STUDIES. XII. STERIC INHIBITION OF
RESONANCE IN THE VAPOR PHASE, by G. G. Smith
and D. V. White. [1964] [3]p. incl. diagr. tables, refs.
(AFOSR-65-0536) (AF AFOSR-62-266) AD 613921
                                      Unclassified

Also published in Jour. Org. Chem., v. 29: 3533-3535,
Dec. 1964.

A careful determination of the absolute reaction rate
constants for the vapor phase thermal decomposition of
1-(4'-methoxyphenyl)ethyl acetate and its 3'-methyl and
3',5'-dimethyl derivatives provides convincing evi-
dence that π-orbital overlap of the methoxy substituent
with the π-electrons of the ring is markedly reduced by
steric hindrance of methyl groups ortho to the methoxy
substituent. Therefore, steric inhibition of resonance
is a property of the molecule and does not require solva-
tion of the substituents.

2931

Utah U. [Dept. of Chemical Engineering] Salt Lake City.

IGNITION AND COMBUSTION OF SOLID PROPEL-
LANTS, by R. C. Mitchell, J. A. Keller and others.
Oct. 1, 1962-Sept. 30, 1963, 76p. (AFOSR-64-1665)
(AF AFOSR-63-40) AD 605729   Unclassified

The spreading rate of the flame zone on the surface of
a solid propellant was studied by use of a rarefaction
tube. Cold gas flow past the burning zone and across
the unburned surface produced high flame spread veloci-
ties. The experimental data were interpreted and cor-
related in terms of two theoretically predicted but ex-
perimentally determined parameters. Data obtained by
subjecting composite propellant surfaces to thermal
radiation fluxes in the range of 2-13 cal/(sec) (sq cm)
were adequately explained in terms of a simple ignition
theory. A comparison of the ignition characteristics of
several types of catalyzed, composite ammonium-based
propellants and of propellant type materials formed by
pressing AP and non-volatile carbon black or graphite

indicated that, in the range of heat fluxes studied, ignition occurs by decomposition of AP followed by a reaction between the decomposition products and solid fuel binder.

2932

Utah U. [Dept. of Chemical Engineering] Salt Lake City.

COMBUSTION IRREGULARITIES OF SOLID PROPELLANTS, by N. W. Ryan. Progress rept. Sept. 1, 1963-June 30, 1964. Aug. 10, 1964, 11p. (AF AFOSR-63-446) AD 454553   Unclassified

The project progress is summarized along three distinct lines, (1) the study of acoustic instability in a T-burner, (2) the study of non-acoustic instability, and (3) an attempt to develop a gas-burning engine for studying instability with a truly homogeneous, relatively simple combustion system.

2933

Utah U. Dept. of Chemical Engineering, Salt Lake City.

IGNITION AND COMBUSTION OF SOLID PROPELLANTS, by J. A. Keller, A. D. Baer, and N. W. Ryan. Final rept. Oct. 1, 1963-Sept. 30, 1964 [72]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0936) (AF AFOSR-64-40)   Unclassified

The results of the study of propellant ignition by high convective heat fluxes have shown that the gas velocity effect often observed in convective heating tests can be attributed to surface roughness. If this surface roughness effect is eliminated by the use of very smooth propellant surfaces or by use of very high gas velocities which prevent ignition of projections on the surface, the relationship between ignition time and surface heat flux is simply the extrapolation of the low-flux ignition data. Also, it appears that the effect of a burning rate catalyst is to increase the rate of reaction of propellant-component decomposition products at the propellant surface. Modification of the thermal ignition theory to include the effects of surface regression for high igniter heat fluxes has lead to results which indicate that an ignition-pressure effect on the overall ignition process can be observed when practical ignition systems even when the thermal response of the propellant itself is independent of pressure. The problem of transition from ignition to steady-state burning can be approximately treated by this model.

2934

Utah U. Dept. of Metalhurgy, Salt Lake City.

INVESTIGATION OF THE RECRYSTALLIZATION BEHAVIOR OF DILUTE ALLOYS OF MAGNESIUM AND CHROMIUM, by C. H. Pitt, E. L. Moore and others. Dec. 1964, 66p. incl. illus. diagrs. tables, refs. (Technical rept. no. 1) (AFOSR-65-0755) (AF AFOSR-63-39) AD 615620   Unclassified

An investigation into the recrystallization behavior of

pure magnesium and some of its dilute binary alloys and pure chromium has been made. Techniques for preparing thin foils of magnesium suitable for examination in the electron microscope have been developed and photographs taken of dislocations, nucleation of dislocations and migrating grain boundaries. An x-ray technique was developed to measure the degree of recrystallization of magnesium and it was found that surface recrystallization played an important part in the recrystallization process. Activation energies determined for surface recrystallization in magnesium and its alloys range from 28 to 31 kcal/mol while that for bulk recrystallization was 20 kcal/mol. Determination of the percent recrystallization in pure chromium was done by a microscope technique. The activation energy for the recrystallization of pure chromium, i.e., 99.997%, was found to be 76 kcal/mol.

2935

Utah U. [Dept. of Physics] Salt Lake City.

THE EFFECTS OF OPTICAL PROPERTIES ON THIN FILMS ON POLARIZATION AND INTENSITY OF LIGHT DIFFRACTED THROUGH WIDE ANGLES, by F. S. Harris, Jr. and G. R. Orme. [1963] [5]p. (AFOSR-64-1972) (AF 49(638)799) AD 452504   Unclassified

Presented at meeting of the Internat'l. Commission for Optical Materials, Paris (France), July 7, 1961.

Also published in Opt. Acta, v. 10: 293-297, Oct. 1963.

The effect of the edge material and the wavelength on wide-angle diffraction was investigated with a sensitive photomultiplier photometer. Measurements of as little as 10^{-8} fraction of the incident light at an angle of 70° showed the effect on the intensity and polarization of the diffracted light due to the nature of the edge material and depending on the wavelength used.

2936

Utah U. Dept. of Psychology, Salt Lake City.

IDENTIFYING RESEARCH CHARACTERISTICS IN HIGH SCHOOL STUDENTS—A SECOND STUDY, by C. W. Taylor, E. Nielsen and others. Aug. 1964, 1v. incl. tables, refs. (AFOSR-64-2261) (AF AFOSR-63-11) AD 609485   Unclassified

An attempt was made to discover the best predictor of creative scientific talent in high school students. A new study was undertaken with a three-fold purpose: (1) to focus on improving the spread of criterion rating scores over those obtained in the first study of the research participation programs; (2) to obtain cross validities on the best predictors used in the previous summer's study study; and (3) to provide an opportunity to try out a few new predictor instruments.

2937

Utah U. Dept. of Psychology, Salt Lake City.

INFORMATION AND SCIENTIFIC CREATIVITY, by
C. W. Taylor. [1964] 20p. incl. refs. (AFOSR-64-
2502) (AF AFOSR-63-144) AD 609486   Unclassified

Presented at Second Symposium of the Federal Council
for Science and Technology on Technical Information
and the Federal Laboratory, Apr. 13, 1964.

In this paper the problem of studying what constitutes
effectiveness and creativity in a scientist is discussed.
The way the scientist receives and handles information,
the intellectual climate in which he works, and the na-
ture of the information received by him are all examined
in their bearing on the creative process.

2938

Vanderbilt U., Nashville, Tenn.

LUMINOUS FRONT THICKNESS IN ELECTRIC SHOCK
TUBES, by J. P. Barach and J. A. Sivinski. [1964]
[3]p. incl. diagrs. (AFOSR-64-1985) (AF AFOSR-63-
287) AD 452382   Unclassified

Also published in Jour. Appl. Phys., v. 35: 1426-
1428, May 1964.

Five electric shock tube arrangements have been stud-
ied by means of photomultiplier signals. The rise time
of the luminous front as it passes the detector station
is converted to a thickness by means of the measured
front speed. These thicknesses are correlated with
initial conditions of pressure from 0.15 to 5.0 Torr of
argon, and input power from 0.8 to 262×10^6 w, for
tubes with luminous front speeds from 3 to 30 mm/μ
sec. For each tube the front thickness increases with
input energy and, in general, the thickness of the lumi-
nous transition zone is proportional to the peak cur-
rent. Identification of the luminous front is with the
"hairpin" driving current, rather than with a shock
wave initiated by it. A maximum current density pic-
ture of this driving current is suggested by the data.

2939

Vanderbilt U., Nashville, Tenn.

PRECURSOR ARC IN AN ELECTRIC SHOCK TUBE,
by J. P. Barach and J. A. Sivinski. [1964] [2]p. incl.
illus. diagrs. refs. (AFOSR-64-2310) (AF AFOSR-
63-287) AD 451930   Unclassified

Also published in Phys. Fluids, v. 7: 1075-1076, July
1964.

As part of an investigation into the characteristics of
the flow in electric shock tubes, a grounded probe of
fine copper wire was inserted downstream in a coaxial
shock tube. An arc of some hundreds of amperes then
preceded the shock front, running from the high voltage
powering electrode to this ground wire. This arc can
extend quite far downstream and currents of a few am-
peres can still be drawn with the wire separated by as
much as 5 microhms from ground. Other electric
shock-tube workers may have such arcs in their tubes
and they may cause ambiguous results such as the ap-
pearance of double structure to the front. The pre-
cursor arc may also be of interest as a means of pro-
ducing and studying appreciable precursor electron
densities in electric shock tubes. It also is a means
of increasing shock velocities by heating the gas im-
mediately ahead of the front.

2940

Vanderbilt U., Nashville, Tenn.

FLUX TRANSPORT BY A SHOCK PLASMA, by J. P.
Barach and J. H. Lee. [1964] [6]p. incl. illus. diagrs.
refs. (AFOSR-64-2311) (AF AFOSR-63-287)
AD 452411   Unclassified

Also published in Phys. Fluids, v. 7: 1366-1371, Aug.
1964.

A magnetic field of about 50 G is observed to be trans-
ported downstream from a sharply localized dc field up
to 34 kG interacting tranversely with a shock produced
plasma flow of velocity up to 2 cm/μsec. The trans-
ported flux is found to be antiparallel to the imposed
field and to decay exponentially in time as it moves
downstream. The decay of the flux gives an estimate
of the gas conductivity. The amount of trapped flux is
in agreement with an approximate theory in which the
decay of the initial trapped flux, the magnetic decelera-
tion of the flow, and the reduction of the conductivity by
the magnetic field are considered. The initial trapped
flux is found to be proportional to the reduced conduc-
tivity and the flow velocity, as expected. However an
increase in the imposed field beyond 17,000 G reduces
the trapping effect due to reductions in both the conduc-
tivity and the exit flow velocity of the plasma. The e-
folding time for field decay is roughly 3.5 μsec and does
not increase with increasing shock speed. (Contractor's
abstract)

2941

Victoria U. [Dept. of Chemistry] Wellington
(New Zealand).

SURFACE ADSORPTION OF Co^{57}, Fe^{57} ON IRON(II)
AND COBALT(II) OXALATES, by P. R. Brady and J.
F. Duncan. [1964] [6]p. (AFOSR-64-1503)
(AF AFOSR-63-27) AD 446357   Unclassified

Also published in Jour. Chem. Soc., v. 130: 653-658,
Feb. 1964.

The Mossbauer spectra of sources prepared by adsorp-
tion of Co^{57}, Fe^{57} on surfaces of iron (II) and cobalt(II)
oxalate were compared with those obtained when the
solids were (a) co-precipitated with these radionuclides
and (b) used as absorbers with a monochromatic
Co^{57}, Fe^{57} source. Some 40% of the adsorbed iron
atoms were strongly held on the surfaces in positions
which did not appear to be chemically very different
from the normal positions in the lattices of these solids.
However, when iron(II) oxalate was heated at its tem-
perature of decomposition, the characteristic reso-
nance lines weakened and became unobservable.

2942

Vienna U. Inst. for Theoretical Physics (Austria).

ELASTIC SCATTERING OF NEGATIVE PIONS AT 16
BEV/C, by G. Czapek, G. Kellner and others. June
15, 1962 [11]p. incl. diagrs. refs. (Scientific note no.
5) (AFOSR-3102) (AF 61(052)433)   Unclassified

Presented at Aix Conf on Elementary Particle Phys-
ics, Sept. 1961.

This paper shows the experimental results from elastic
scattering of high energy negative pions on protons.
A total cross-section of (26.8 ± 1) mb and an elastic

cross-section of (4.2 ± 0.5) mb were found. The differential elastic cross-section turned out to be in good agreement with an optical model (imaginary potential or grey disk).

2943

Virginia Inst. for Scientific Research, Richmond.

A STUDY OF THE GROWTH AND PERFECTION OF SINGLE CRYSTALS OF THE RARE EARTHS AND AL-KALI METALS, by J. F. Kirn. Feb. 1, 1961-Jan. 31, 1963, 23p. incl. illus. diagrs. tables, refs. (AFOSR-J1355) (AF AFOSR-61-41) AD 426565   Unclassified

Single crystals of sodium and potassium were prepared by the Czochralski techniques in glass vessels under vacuum or an argon atmosphere. Methods of cutting, orienting, and studying the samples microscopically were developed. Chlorinated hydrocarbons show considerable promise as etchants. An arc-image furnace was constructed and single crystals of nickel were prepared. The major problem in the use of this furnace is temperature control.

2944

Virginia Polytechnic Inst. Dept. of Chemistry, Blacksburg.

THE KINETICS OF THE CHROMIUM(VI)-ARSENIC(III) REACTION IN ACETIC ACID-ACETATE BUFFER SO-LUTIONS, by J. G. Mason and A. D. Kowalak. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-64-2204) (AF AFOSR-63-210) AD 452404   Unclassified

Also published in Inorg. Chem., v. 3: 1248-1251, 1964.

The kinetics of the oxidation of As(III) by Cr(VI) have been investigated over a wide range of As(III) and Cr(VI) concentrations in 0.2 M acetic acid-0.2 M potassium acetate buffers and a constant ionic medium of 1.5 M adjusted with potassium nitrate.

2945

Virginia U. Research Labs. for the Engineering Sciences, Charlottesville.

A MAGNETIC WIND TUNNEL BALANCE, by H. M. Parker and A. R. Kuhlthau. Feb. 1964, 20p. (AFOSR-64-0567) (AF AFOSR-62-92) AD 434844
Unclassified

A preliminary model of a 3-D wind tunnel balance, which has been constructed and operated in low speed continuum flow for the purpose of demonstrating the feasibility of the approach is described in this report.

2946

[Vitro Corp. of America]. Vitro Labs., West Orange, N. J.

FLUID TRANSPIRATION THROUGH ANODIC BOUND-ARY OF AN ELECTRIC ARC, by C. Sheer, J. A. Cooney, and D. L. Rothacker. [1964] [7]p. incl. illus. diagrs. table, refs. (AFOSR-64-0917) (AF 49(638)-477) AD 439870   Unclassified

Also published in AIAA Jour., v. 2: 483-489, Mar. 1964.

Consideration of the distribution of dissipated energy in a free-burning arc indicates that the major portion of the input energy is concentrated at the anode-gas interface. This leads to the concept of introducing a working fluid into the arc via the anodic boundary by transpiration through a porous anode. Using porous graphite of sufficiently fine pore size and an inert gas medium, this technique is shown to be successful in generating a sustained plasma-jet without a water-cooled channel or other thermal constraint. At power levels below 10 kw, energy transfer to the gas is in the range 70.8 to 88.5% of input.

2947

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

A POSSIBLE COMPROMISE BETWEEN ROCKET AND ATMOSPHERIC BRAKING, by L. Moulin. June 1964, 42p. (Scientific rept. no. 3; VKIFD TN-17) (AFOSR-64-1139) (AF EOAR-63-39) AD 602391
Unclassified

An attempt was made to optimize the problem of recovering an interplanetary vehicle through the earth's atmosphere. Optimum conditions are defined as the ones which would minimize the dead weight, which includes the fuel required for eventual rocket braking outside the atmosphere, and the mass which is ablated for heat protection during the flight into the atmosphere. It is shown that when chemical or nuclear propulsion is considered, pure atmospheric braking is always the best solution, but when electrical propulsion can be used, an optimum compromise between partial rocket and atmospheric braking may exist, depending upon the respective qualities of the propulsion system and ablating material.

2948

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

APPROXIMATE ANALYSIS OF OPTIMUM LOW THRUST TRANSFER BETWEEN COPLANAR HYPER-BOLIC ORBITS, by L. Moulin. May 1964 [22]p. incl. diagrs. (Scientific rept. no. 2; VKIFD TN-15) (AFOSR-64-1140) (AF EOAR-63-39)   Unclassified

Optimization of low thrust transfer between coplanar hyperbolic orbits has been analyzed, on the basis of an

approximate analytical solution, in the case of constant thrust set at a constant angle to the velocity vector. The investigation bears upon minimization of fuel consumption and selection of an ideal initial orbit. For given initial and final orbits it is shown that optimum conditions can be obtained with tangential thrust. Further refinement consists of a proper selection of the angular momentum of the initial orbit, so as to either initiate or terminate low thrust propulsion as close as possible to perigee, depending upon the direction of transfer.

2949

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

NOTE ON THE USE OF CHEBYSHEV POLYNOMIALS FOR INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS, by L. Moulin. June 1964 [24]p. incl. diagrs. (Scientific rept. no. 4; VKIFD TN-18) (AFOSR-64-1293) (AF EOAR-63-39) AD 603740
Unclassified

The problem of obtaining approximate solutions to ordinary differential equations is discussed with reference to methods which are already in existence. In addition, the possibility has been considered of using direct expansions in Chebyshev polynomials. The analysis indicates that such a method compares favorably with other methods, and may offer further advantages. It is also shown that its application can also be easily extended to the case of nonlinear equations.

2950

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

OPTIMIZATION OF RECOVERY TRAJECTORIES FOR SPACE VEHICLES, by L. Moulin. Final scientific rept. Sept. 30, 1964 [27]p. incl. diagrs. (AFOSR-64-2481) (AF EOAR-63-39) AD 609573   Unclassified

It is shown that optimum recovery conditions must be defined as the ones which minimize an overall dead-weight which must include the fuel for eventual rocket braking outside the atmosphere, and the mass which is ablated for heat protection into the atmosphere. The results indicate that when chemical or nuclear propulsion is considered, pure atmospheric braking will always be the best solution, but when electrical propulsion is used, an optimum compromise between partial rocket and atmospheric braking may exist, depending upon the respective properties of propulsion system and ablating material. (Contractor's abstract)

2951

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

APPROXIMATE ANALYTICAL SOLUTION FOR LOW

THRUST PROPULSION IN SPACE, by L. Moulin. May 1964, 43p. (Scientific rept. no. 1; VKIFD TN-16) (AF EOAR-63-39) AD 603175   Unclassified

Approximate analytical solutions were derived for the problem of low thrust propulsion, in the case of constant thrust, set at a constant angle to the velocity vector, for any type of initial orbit (elliptic, parabolic or hyperbolic). Simple expressions were obtained, giving energy, angular momentum and excentricity in terms of the excentric anomaly. The solutions allow for calculation of the fuel consumption. Their validity is restricted to the field of orbit correction.

2952

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

MODULATION TECHNIQUES FOR MEASUREMENTS IN LOW DENSITY HYPERSONIC WIND TUNNELS, by J. J. Smolderen. [1964] [15]p. incl. illus. diagr. (AFOSR-64-1875) (AF EOAR-63-41) AD 607382
Unclassified

Presented at Twenty-second Semi-annual Supersonic Tunnell Association meeting, Sept. 24-25, 1964.

A new technique for the measurement of small forces or other low level effects has been developed at the VKIFD low density wind tunnel. Measurement of forces as low as 10 μg appear feasible using ferroelectric transducers in conjunction with a low level tuned amplifier system and synchronous demodulator. This performance is made possible by periodically screening the flow on the model or even chopping the full flow of the wind tunnel by means of a mechanically actuated screen. Such modulation techniques, which result in considerable noise and drift reduction because of the narrow band width of a system using synchronous demodulation are widely used for the measurement of low level dc signals as well as detection of weak radiation, molecular beams, biological phenomena, etc.

2953

[Von Karman Inst. for Fluid Dynamics, Brussels (Belgium)]

LAMINAR SEPARATION IN SUPERSONIC FLOW, by J. J. Ginoux. Final rept. Nov. 1, 1962-Sept. 30, 1963 [59]p. incl. illus. diagrs. refs. (AFOSR-64-0122) (AF EOAR-63-45) AD 429780   Unclassified

A study of three-dimensional flow perturbations in laminar supersonic flows was made on flat plates with swept-back leading edges and in the reattachment region of the flow over flat plates with backward-facing steps. It was shown that a cross-flow existed in the boundary layer on flat plates with supersonic sweptback leading edges of small bluntness, which increased in magnitude from the centerline towards the sides of the models. In separated flows, only an extremely small amount of cross-flow was needed to destabilize the flow and to create regular spanwise variations in total pressure. Larger cross-flows, controlled by a systematic

variation of the angle of sweep either of the leading edge or of the edge of the step, had no further effect.

2954

[Von Karman Inst. for Fluid Dynamics] Brussels (Belgium).

A STEADY-STATE TECHNIQUE FOR LOCAL HEAT-TRANSFER MEASUREMENT AND ITS APPLICATION TO THE FLAT PLATE, by J. J. Ginoux. [1964] [9]p. incl. diagrs. table. (AFOSR-64-1889) (AF EOAR-63-45) AD 450004   Unclassified

Also published in Jour. Fluid Mech., v. 19: 21-29, 1964.

Comparison between theory and experiment has been made in the simple case of a flat plate with constant heat flux for which a rigorous computation could be made based on the theory of Chapman and Rubesin (1949). The model was so conceived that the heat losses were small enough to be neglected. Therefore no corrections, which are often inaccurate, were needed for the experimental results, contrary to what is generally done when using other techniques for heat-transfer measurements. The theoretical analysis showed that the measurements are simply related to the results that could be obtained in the case of an iso-

thermal surface, because of the constant ratio that exists between the corresponding heat-transfer coefficients.

2955

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

LAMINAR SEPARATION IN SUPERSONIC FLOW, by J. J. Ginoux. Final rept. Nov. 1, 1963-Oct. 31, 1964 [69]p. incl. illus. diagrs. refs. (AFOSR-65-0352) (AF EOAR-64-7) AD 612407   Unclassified

Detailed experimental investigations were made at a Mach number of 2.21 of laminar flows over ramps, backward facing steps and swept back wings. Large spanwise variations of the heat transfer coefficient (h) were measured, with two different techniques, in the reattachment region of the flow over a backward facing step and were related to streamwise vortices present in the laminar boundary layer. Peaks in h much larger than the turbulent value were measured. By comparing spanwise total head and heat transfer rate distributions, Reynolds analogy was found to apply quantitatively for reattaching flows with streamwise vortices. The effect of free-stream Reynolds number and of leading edge sweep, accuracy of machining, thickness and bevel angle on the intensity of streamwise vortices present in the boundary layer on swept back wings was investigated. Flow separation was detected at the leading edge.

2956

Wales U. Coll. Dept. of Agricultural Biochemistry, Aberystwyth.

SOME APPLICATIONS OF THIN LAYER CHROMA-
TOGRAPHY TO BIOSYNTHETIC STUDIES, by T. W.
Goodwin. [1964] [4]p. incl. illus. (AFOSR-64-2167)
(AF EOAR-63-24) AD 452366   Unclassified

Also published in Lab. Practice, Apr. 1964.

It is not the purpose of this article to describe the
basic techniques of thin-layer chromatography, which
are now so well known, but to indicate the versatility of
this elegantly simple procedure by outlining some of
the applications which have been so useful in studies on
terpenoid and lipid biosynthesis in plants. Five ex-
amples are considered, each of which emphasizes a dif-
ferent facet of the overall usefulness of thin-layer
chromatography. (Contractor's abstract)

2957

Wales U. Coll. Edward Davies Chemical Lab.,
Aberystwyth.

PYROLYSIS OF ETHYL-, N-PROPYL-, AND N-
BUTYL-BENZENE AND THE HEATS OF FORMATION
OF THE BENZYL AND N-PROPYL RADICALS, by G.
L. Esteban, J. A. Kerr, and A. F. Trotman-
Dickenson. [1963] [7]p. (AFOSR-J1011) (AF EOAR-
63-23) AD 642867   Unclassified

Also published in Jour. Chem. Soc. (London), v. 719:
3873-3879, July 1963.

Pyrolyses of ethyl-, n-propyl-, and n-butyl-benzene,
studied by an aniline-carrier technique, proved to be
unimolecular, homogeneous decompositions into alkyl
and benzyl radicals and to have the following rate
constants: ethylbenzene (603-727°), $\log k \ (\sec^{-1})$ =
14.6 - (70,100/2.3RT); n-propylbenzene (587-735°),
$\log k \ (\sec^{-1})$ = 14.9 - (68,600/2.3RT); and n-butyl-
benzene (590-735°) $\log k \ (\sec^{-1})$ = 14.5 - (67,200/2.3
RT). From the first two results $D(C_6H_5CH_2-H)$ =
14.6; and from the third, $D(C_6H_5CH_2-H)$ = 96.2
kcal/mol^{-1}.

2958

[Wales U. Coll.] Edward Davies Chemical Lab.,
Aberystwyth.

PYROLYSES OF NN-DIMETHYLANILINE, CUMENE,
AND PHENYLHYDRAZINE, AND BOND STRENGTHS
IN AROMATIC AMINO-COMPOUNDS, by J. A. Kerr,
A. F. Trotman-Dickenson, and M. Wolter. [1964]
[5]p. incl. tables. (AFOSR-65-1474) (AF EOAR-63-
23) AD 622577   Unclassified

Also published in Jour. Chem. Soc. (London), No. 693:
3584-3588, Oct. 1964.

Pyrolyses of NN-dimethylaniline, cumene, and phenyl-
hydrazine have been studied by the aniline-carrier

technique and found to be first-order homogeneous
reactions with the following rate constants: NN-dimethyl-
aniline (552-681°) $\log k \ (\sec^{-1})$ = 12.9 - (57,000/2.3RT);
cumene (619-716°) $\log k$ = 14.3 - (66,000/2.3RT);
phenylhydrazine (325-437°) $\log k$ = 11.8 - (40,000/2.3
RT). From the first two values it is deduced that
methyl substitution has about the same weakening effect
on N-C and N-H bond strengths in anilines as on the
corresponding C-C and C-H bonds in alkylbenzenes.
The heat of formation of the amino-radical derived from
the pyrolysis of phenylhydrazine agrees with a revised
figure [$\Delta H_f^0(NH_2)$ = 39.3 kcal mol^{-1}] from the pyrolysis
of hydrazine. (Contractor's abstract)

2959

Warner and Swasey Co., Flushing, N. Y.

RECENT DEVELOPMENTS IN GAS PROPERTY BY
SPECTROSCOPIC METHODS, by R. H. Tourin.
Sept. 10, 1963, 12p. (Rept. no. 63WA252) (AFOSR-
J1483) (AF 49(638)1132) AD 427539   Unclassified

A monochromatic gas radiation pyrometer has been
developed for application of several spectroscopic
methods of gas temperature measurement. These
methods have been applied to temperature measurement
in combustion exhausts, gas flames, liquid propellant
flames, solid propellant flames, plasmajets and arcs,
detonations and shocks.

2960

Warner and Swasey Co.., Flushing, N. Y.

[INFRARED TEMPERATURE DISTRIBUTION MEAS-
UREMENT IN COMBUSTION GASES] by B. Krakow and
R. H. Tourin. Final summary rept. Dec. 10, 1964,
6p. (AFOSR-65-0207) (AF 49(638)1132)
          Unclassified

An investigation was made of the relations between
temperature gradients in hot gases and the infrared
radiation emitted and absorbed by the specimen. Theo-
retical and mathematical analyses produced working
equations, processes for solving them in terms of
thermal structure, knowledge of what measurements and
information about the working fluid are needed for the
solutions, and the necessary restrictions on measure-
ment methods. An experimental program was carried
out, using CO_2 as the working molecule, to test the theo-
retical and mathematical procedures devised. They
proved workable. (Contractor's abstract)

2961

Washington State U. [Dept. of Physics] Pullman.

THE EFFECT OF FILAMENT IMPURITIES ON THE
OPERATION OF BAYARD-ALPERT IONIZATION
GAUGES, by D. R. Denison, H. F. Winters, and E. E.
Donaldson. [1963] [5]p. incl. illus. diagrs. table.
(AFOSR-64-0884) (AF AFOSR-63-86)
AD 438675   Unclassified

Also published in Trans. Tenth Nat'l. Vacuum Symposium, Amer. Vacuum Soc., Boston, Mass. (Oct. 16-18, 1963), ed. by G. Bancroft. New York, Macmillan Co., 1963, p. 218-222.

The operating of the Bayard-Alpert ionization gauge is studied for low emission currents at pressures below 10^{-8} torr. It is shown that the sodium or potassium impurities normally present in the filament are liberated by chemical etching of the filament or by diffusion. These impurities reach the grid where they are adsorbed. Subsequent bombardment of the grid by electrons releases these impurities as ions which reach the collector of the gauge and which produce an anomalous ion current directly related to the pressure. (Contractor's abstract)

2962

Washington State U. [Dept. of Physics] Pullman.

ADSORPTION OF GASES ACTIVATED BY ELECTRON IMPACT, by H. F. Winters, D. E. Horne, and E. E. Donaldson. [1964] [7]p. incl. diagrs. refs. (AFOSR-65-0531) (AF AFOSR-62-86) AD 613866
Unclassified

Also published in Jour. Chem. Phys., v. 41: 2766-2772, Nov. 1, 1964.

Adsorption of nitrogen which has been activated by electron impact is shown to result from dissociation of the nitrogen molecule and from the interaction of energetic ions with a nickel surface. Excitation of N_2 to states at about 10.3, 12.2, and 14.6 ev causes dissociation. Dissociative ionization at 24.5 ev also leads to additional pumping. Energetic N_2 ions have an adsorption probability of approximately 0.85 when they collide with a nickel surface. It is shown that the ion adsorption probability is practically independent of energy between 30 and 100 ev. It is also shown that thermal energy ions have a very low adsorption probability. These results lead to the postulate that the N_2 ions dissociate in impact and that the atomic nitrogen is subsequently adsorbed. Results have also been obtained which indicate that the adsorption probability of Ar is strongly dependent on surface structure. Annealing of the surface greatly reduces the adsorption probability. (Contractor's abstract)

2963

Washington State U. Dept. of Psychology, Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF ITEM FREQUENCY, by K. E. Lloyd. [1964] [5]p. incl. tables. (AFOSR-65-2164) (AF 49(638)805) AD 629082
Unclassified

Also published in Jour. Psychol., v. 58: 249-253, 1964.

The daily frequency of occurrence of items (letter-word pairs) was varied in a sequential memory task. In this task, S continually received information and, at unpredictable moments, was requested to recall some of it. Two groups of Ss which differed in the range of varia-

tion in item frequencies in the sequences presented to them were compared. Total recall was directly related to range of item frequency ($p < .01$). High-frequency items in a high-range group were recalled more often than medium-frequency items in a narrow range group ($p < .01$). Items with a low frequency in both the groups were recalled most often by the highest-range group ($p < .05$). The facilitation of recall in the highest-range groups was not limited to the high-frequency items. (Contractor's abstract)

2964

Washington State U. [Dept. of Psychology] Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF WORD FREQUENCY, by K. E. Lloyd. [1964] [4]p. incl. table, refs. (AFOSR-65-2165) (AF 49(638)805) AD 629383
Unclassified

Also published in Jour. Verbal Learning and Verbal Behav., v. 3: 286-289, Aug. 1964.

The English text frequency of words used in a sequential-memory task was manipulated. In this task S continually received new words to be remembered, and, at unpredictable moments, was requested to recall some of them. Three groups of Ss were compared. One group was presented high-frequency words, another low-frequency words, and a third was presented words which varied in frequency over a wide range. Recall varied as a function of word frequency. Differences in recall were greater when the memory requirements of the task were low than when they were high. (Contractor's abstract)

2965

Washington State U. [Dept. of Psychology] Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF RECALL POINT CODING, by K. E. Lloyd. [1964] [3]p. (AFOSR-64-1163) (AF AFOSR-63-256) AD 442834
Unclassified

Also published in Psychol. Repts., v. 14: 752-754, 1964.

Recall is facilitated if items to be stored are easily coded into familiar chunks. The means of coding the items is usually obvious at the time they are presented. The purpose of the present study was to learn if recall was facilitated when the basis for coding a stored item was delayed until the time of recall. The results indicated a substantial improvement in recall as the appropriateness of the recall point for the stored item was increased. This improvement varied inversely with the storage requirements of the task.

2966

Washington State U. [Dept. of Psychology] Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF ITEM

VALUE, by K. E. Lloyd. [1964] [2]p. (AFOSR-64-1302) (AF AFOSR-63-256) AD 444266 Unclassified

Also published in Perceptual and Motor Skills, v. 18: 297-298, 1964.

Ss stored and recalled unrelated words which differed in their penny value (Group I). The number of words being stored at any one time was also varied. Recall errors decreased regularly from low to high value words in Group I, and remained relatively constant in Group II. Errors varied directly with the storage load at all word value.

2967

Washington U. [Dept. of Physics] St. Louis, Mo.

THE PRIMARY COSMIC-RAY ALPHA PARTICLE ENERGY SPECTRUM IN TEXAS AT A TIME NEAR SOLAR MAXIMUM, by D. E. Guss. 1963, 107p. (AFOSR-130) (AF 49(638)833) AD 414422
Unclassified

The present experiment was designed to study the shape of the alpha particle energy spectrum at kinetic energies above 2 bev/nucleon. By the selection of glass backed emulsions, as opposed to emulsion strips and by designing the processing procedure to reduce emulsion distortions to a minimum, it was possible in the present set of emulsions to measure alpha particle kinetic energies up to 7.5 bev/nucleon.

2968

Washington U. Dept. of Physics, St. Louis, Mo.

GATED INTEGRATOR FOR REPETITIVE SIGNALS, by J. Reichert and J. Townsend. [1964] [6]p. incl. diagrs. (AFOSR-65-0804) (AF AFOSR-62-320) AD 616222 Unclassified

Also published in Rev. Scient. Instr., v. 35: 1692-1697, Dec. 1964.

A gated integrator, using standard analog computing amplifiers, is described. Because of the placement of the diode gate within the feedback integrating loop, many of the previous requirements of high quality insulation and high input impedance electrometers are eliminated. The "holding time" of the integrator is such that, for an "integrating time" of 10^{-4} sec, the time required for a drift of 1% of full-scale (50 v output) is at least 17 min. The minimum sampling time is 0.5 μ sec. A method for taking data using 2 such integrators and a calibrated signal is also presented. (Contractor's abstract)

2969

Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRONIC INTERACTION IN KETYL RADICALS, by N. Hirota and S. I. Weissman. [1964] [8]p. (AFOSR-64-2305) (AF AFOSR-62-365) AD 452409
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2538-2545, July 5, 1964.

The existence of paramagnetic dimers of ketyls was confirmed from e.s.r. and optical absorption spectra. Spin-spin dipolar interactions in the dimers were studied from the e.s.r. spectra in rigid media and are discussed in connection with their structures. Slow spin exchange rates were found in the dimers. The equilibria among various forms of ketyls (paramagnetic monomer, paramagnetic dimer, and diamagnetic dimer) are discussed and several thermodynamic quantities are given for the paramagnetic monomer-dimer equilibrium. The factors which affect the equilibria are also discussed.

2970

Washington U. [Dept. of Physics] St. Louis, Mo.

RATES OF OXIDATION-REDUCTION REACTIONS BETWEEN KETYLS AND KETONES, by N. Hirota and S. I. Weissman. [1964] [2]p. incl. diagrs. table. (AFOSR-64-2306) (AF AFOSR-62-365) AD 451936
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2537-2538, July 5, 1964.

The kinetics for the reaction $R^- M^+ + R \rightarrow R + M^+ R$ where M is an alkali metal and R an aromatic ketone have been determined by electro spin resonance spectroscopy. The reactions are first order with respect to each of the reactants. Rate constants between 10^7 and 10^9 M^{-1} sec^{-1} and activation energies between 4 and 6 kcal mol^{-1} were found.

2971

Washington U. [Dept. of Physics] St. Louis, Mo.

EXPERIMENTAL STUDIES IN NUCLEAR PHYSICS, by F. B. Shull, J. M. Fowler and others. Final rept. Aug. 1, 1962-June 30, 1963, 1p. (AFOSR-5284) (AF AFOSR-62-428) AD 417349 Unclassified

Research activities and accomplishments are reported in 2 major sections. The first consists of a study of the Mossbauer effect in β-tin over the temperature range from 1.3° to 370°K, which did not require cyclotron operation for its continuation and a report of the analysis of differential cross-sections of several (d, α) reactions. The second section reports on the progress of the cyclotron redevelopment program and describes current operations and projections for the near future.

2972

Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRON-EXCHANGE REACTION OF WURSTER'S BLUE IN AQUEOUS SOLUTION, by A. D. Britt. [1964] [3]p. incl. table, refs. (AFOSR-66-2633) (AF (AFOSR-65-771) AD 645169 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3069-3071. Nov. 15, 1964.

The electron exchange between Wurster's Blue and N, N, N', N'-tetramethyl-p-phenylenediamine dihydrochloride is investigated by ESR and NMR. The active form of the dihydrochloride is found to be the neutral diamine, and a simple relationship is derived between the apparent rate constant and the actual rate constant. (Contractor's abstract)

2973

Washington U. Dept. of Chemistry, Seattle.

INFRARED SPECTRA OF CRYSTALLINE C_2H_2, C_2HD, AND C_2D_2, by G. L. Bottger and D. F. Eggers, Jr. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-1547) (AF 49(638)797) AD 446121 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2010-2017, Apr. 1, 1964.

The infrared absorption spectra of polycrystalline films of C_2H_2, C_2HD, and C_2D_2 have been examined at 63°K in the frequency range between 4500 and 450 cm^{-1}. The spectra of the solid state and the gas phase of the various acetylenes are compared and the appropriate vibrational assignments are made. Several adsorptions attributable to combinations of lattice modes and molecular fundamentals were found. The observed multiplet structure of the fundamental vibrations indicates that in the low-temperature modification of C_2H_2 and C_2D_2 the molecules are located at sites of C_{2h} symmetry. Spectra of various solid solutions composed of mixtures of isotopic species were obtained and their significance discussed. The effect of isotopic substitution on the splittings in the ν_5 region led to the conclusion that the dipole-dipole coupling model is sufficient to explain the observed spectra. (Contractor's abstract)

2974

Washington U. Dept. of Chemistry, Seattle.

INFRARED SPECTRUM OF CARBON DIOXIDE, ENRICHED IN OXYGEN-18, by C. V. Berney and D. F. Eggers, Jr. [1964] [11]p. incl. tables, refs. (AFOSR-64-1548) (AF 49(638)797) AD 446130 Unclassified

Also published in Jour. Chem. Phys., v. 40: 990-1000, Feb. 15, 1964.

The spectrum of a sample of CO_2 enriched to ~ atm % with O^{18} was examined in the region 1620-5400 cm^{-1}, using an Ebert grating spectrometer with spectral slit-

widths ranging from 5 to 2.5 cm. Ten previously unreported bands were analyzed and assigned to various species of O^{18} substituted CO_2 and Courtoy's results for $C^{12}O^{16}O^{18}$ in the 2μ region were confirmed. Courtoy's unexpectedly high value for the Fermi resonance constant of this species was confirmed by the separation of previously unreported Fermi-resonant bands. The positions of the 2 bands assigned to $C^{12}O^{18}$ suggest that the resonance constant for this species is larger still. A resonance interaction was found in $C^{12}O^{16}O^{18}$ dependent on the potential constant k_{113}.

2975

Washington U. Dept. of Chemistry, Seattle.

OBSERVATIONS ON ALKYLBORANES, by C. A. Lutz and D. M. Ritter. [1963] [15]p. incl. diagrs. tables, refs. (AFOSR-J1079) (AF 18(600)1541 and AF 49(638)-937) AD 420302 Unclassified

Presented at the Symposium on Organometallic Compounds, Vancouver (Canada), Sept. 4-6, 1962.

Also published in Canad. Jour. Chem., v. 41: 1344-1358, 1963.

Some synthesis and exchange reactions of diborane and its alkyl derivatives and of the higher boron hydrides were reviewed as background for new work. In pursuit of an idea prompted by knowledge of the deuterium and B^{10} exchanges found for the reactive and unstable higher boron hydrides B_4H_{10} and B_5H_{11}, mono- and dimethyldihydropentaborane and methyltetraborane have been prepared by direct reaction between the parent higher hydrides and 1, 2-dimethyldiborane or monomethyldiborane. The identity and the reactions of each product have been delineated by gas chromatographic separation, gas density, and mass, infrared, and nmr spectrometry. The H^1 nmr spectrum of dihydropentaborane has been reinterpreted and used to decide that monomethyldihydropentaborane is probably a B_{111} derivative which displays stereoisomerism. (Contractor's abstract)

2976

Washington U. [Dept. of Chemistry] Seattle.

HEXABORANE-12 ISOLATION AND IDENTIFICATION by C. A. Lutz, D. A. Phillips, and D. M. Ritter. [1964] [4]p. (AFOSR-64-2265) (AF AFOSR-63-102) AD 452407 Unclassified

Also published in Inorg. Chem., v. 3: 1191-1194, Aug. 1964.

Hexaborane-12 has been isolated in a good state of purity by application of gas chromatography to separation of the products from several boron hydride interconversions. Vapor pressures, melting point, elementary analysis, infrared spectra, and monoisotopic mass spectra are reported; the latter in comparison with hexaborane-10 and pentaborane-11.

2977

Washington U. [Dept. of Chemistry] Seattle.

EQUILIBRIA AND PREPARATIVE METHODS FOR
BORON AND SILICON COMPOUNDS, by D. M. Ritter.
Final rept. Nov. 1964, 9p. (AFOSR-64-2384) (AF
AFOSR-63-102) AD 608755   Unclassified

Tetraborane and dihydropentaborane were successfully
methylated by reaction with 1, 2-dimethyl diborane.
Hexaborane-12 was isolated and characterized. Work
in progress concerning the alkylation of dibcranes,
methylated higher hydrides, vinylboranes, and B-Si
bonded compounds is summarized.

2978

Washington U. Dept. of Chemistry, Seattle.

THE HYDRATION OF STYRENES, by W. M. Schubert,
B. Lamm, and J. R. Keeffe. [1964] [3]p. incl. tables.
(AFOSR-65-0231) (AF AFOSR-64-590) AD 611620
                                        Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86:
4727-4729, Nov. 5, 1964.

Evidence is presented which is consistent with the rate-
determining step in the hydration of styrenes being a
proton transfer to styrene to form a carbonium ion:
$H_3O^+ + ArCH = CH_2 \rightarrow H_2O + ArC^+HCH_3 \rightarrow$ products.

2979

Washington U. [Dept. of Electrical Engineering] Seattle.

MAN-COMPUTER INTERFACE STUDY, by D. L.
Johnson and A. L. Kobler. Annual rept. June 1963,
155p. (AFOSR-J1540) (AF AFOSR-62-366)
AD 428649   Unclassified

This report deals with the progress made in the re-
search of the Man-Computer Interface Study. Part I
describes the development of a method for problem
solving and learning related to trigonometry problems.
The methods of solution and learning discussed and
illustrated are sufficiently general that they may be
extended to other areas of problems. Part II is con-
cerned with research in computer game playing. The
principal effort in this section is devoted to tree-
pruning methods as applied to the game of chess.
Part III of the report describes continuing research
dealing with human attitudes toward the man-machine
relationship. The results of an analysis of an attitude
scale are provided and discussed in this section.

2980

Washington U. Dept. of Electrical Engineering, Seattle.

MACHINE LEARNING FOR GENERAL PROBLEM
SOLVING, by D. L. Johnson. Annual rept. Oct. 1964,
316p. incl. diagrs. tables, refs. (AFOSR-64-2290)
(AF AFOSR-64-468) AD 608544   Unclassified

Research relevant to problem solving and learning using
trigonometric processes is described in Part I. The
incorporation of learning into the process of mechanically
proving trigonometric identities presents a unique and
major step in the field of artifical intelligence. The
processes used, and some of the specific techniques and
routines, are sufficiently general that they may be
applied to other forms of learning. Part II is concerned
with research in tree pruning as related to computer
game playing. New min-max methods of pruning have
been developed with particular emphasis placed upon
machine learning to fix pruning parameters. The
programs are operative using the FORTRAN programing
language. A sample game as played by the computer is
included within this section of the report. Some results
of the research dealing with the restraints the man-
machine attitudes play upon human use of digital com-
puters in problem-solving contexts are described in
Part III. (Contractor's abstract, modified)

2981

Washington U. [Dept. of Physics] Seattle.

NUCLEAR MAGNETIC RELAXATION TIMES, by E.
A. Uehling. Final rept. Apr. 2, 1963, 21p. incl. refs.
(AFOSR-4708) (AF 49(638)92) AD 406941
                                        Unclassified

The research done deals principally with those nuclear
relaxation processes in solids which depend on the
presence of an electric quadrupole interaction. The re-
sults fall into 2 broad categories, one of which is con-
cerned with the understanding of the various relaxation
processes which are encountered, and the other in-
volves the measurement of important physical parame-
ters. Probably the most important single result of this
research falls into the second of these two categories.
This is the measurement of an activation energy which
is of importance in connection with deuteron relaxation
in hydrogen bonded crystals. The significance of this
connection is described in detail.

2982

Washington U. [Dept. of Physics] Seattle.

SIMPLE HEAT SWITCH FOR LOW TEMPERATURE
USE, by J. G. Dash and J. Siegwarth. [1963] [2]p.
(AFOSR-64-0450) (AF 49(638)1004) AD 435921
                                        Unclassified

Also published in Rev. Scient. Instr., v. 34: 1276-
1277, Nov. 1963.

A description is presented of the design and performance
of a heat switch suitable for use from room temperatures
to less than 1°K.

2983

Washington U. [Dept. of Physics] Seattle.

MEASUREMENT OF RECOIL-FREE FRACTIONS IN
STUDIES OF THE MOSSBAUER EFFECT, by R. M.

Housley, N. E. Erickson, and J. G. Dash. [1964]
[9]p. incl. diagrs. table, refs. (AFOSR-64-1747)
(AF 49(638)1004) AD 447591   Unclassified

Also published in Nuclear Instr. and Methods, v. 27:
29-37, 1964.

This paper discusses the techniques of measurement of
recoil-free fractions f of resonance gamma rays. A
theoretical analysis extends the validity of the resonance
dip area method, to permit relative f measurements
to be made on emission lines of arbitrary shape. The
method is also applicable to relative f' measurements
on thin absorbers. Some forms of instrumental broaden-
ing do not affect the result. A discussion on background
intensity measurements includes some techniques for
making precise background corrections. Absolute f
measurements are discussed in terms of a very wide
absorption line, which can be considered to approach
the ideal of a black resonance absorber. A mixture of
fluoroferrates, having a composite line width of more
than 1.4 mm/sec, has been developed. The preparation
of nearly black absorbers by compounding the mixture
with iron enriched in Fe^{57}, is described in a detailed
recipe. The absorbers are so nearly ideal that many
f measurements can be made simply, comparing inten-
sities transmitted by a stationary absorber with the
corrected intensity transmitted at high Doppler shifts.
(Contractor's abstract, modified)

2984

Washington U. [Dept. of Physics] Seattle.

VISCOSITY OF LIQUID He II, by J. T. Tough, W. D.
McCormick, and J. G. Dash. [1963] [6]p. (AFOSR-
64-0276) (AF AFOSR-82-298) AD 432532
                              Unclassified

Also published in Phys. Rev., v. 132: 2373-2378,
Dec. 15, 1963.

The viscosity of liquid He has been measured between
1.10°K and the lambda point. A new type of viscometer
was used, based on the damping of the transverse vibra-
tions of a fine wire stretched between 2 rigid supports.
The simplicity of the hydrodynamic problem and the
low nuisance damping of the wire make this technique
particularly appropriate for the measurement of small
viscosities. The smoothed data are presented and
found to be in good agreement with the latest rotating
cylinder viscometer results.

2985

Washington U. [Dept. of Physics] Seattle.

VIBRATING WIRE VISCOMETER, by J. T. Tough, W.
D. McCormick, and J. G. Dash. [1964] [4]p. incl.
diagrs. (AFOSR-65-0398) (AF AFOSR-62-298)
AD 612858   Unclassified

Also published in Rev. Scient. Instr., v. 35: 1345-
1348, Oct. 1964.

The damping of transverse vibrations of a wire in a

viscous fluid is the basis for a viscometer of high pre-
cision and versatility. A solution to the hydrodynamic
problem is indicated, and shown to be valid for a wide
range of physical parameters. The device is simple in
operation and design, adaptable to various decay con-
stant measuring techniques, and requires only a small
volume of sample fluid. The viscosity of liquid helium
II between 1.10°K and the lambda point has been meas-
ured with this technique, and shows a mean scatter of
about 2%. This technique is particularly appropriate
for fluids of low viscosity. (Contractor's abstract)

2986

Washington U. [Dept. of Physics] Seattle.

MEAN-SQUARE DISPLACEMENT OF DILUTE IRON
IMPURITY ATOMS IN HIGH-PURITY BERYLLIUM
AND COPPER, by R. M. Housley, J. G. Dash, and
R. H. Nussbaum. [1964] [3]p1 incl. diagr. table, refs
(AFOSR-65-0186) (AF AFOSR-64-595) AD 456596
                              Unclassified

Also published in Phys. Rev., v. 136: A464-A466,
Oct. 19, 1964.

Absolute values of the Mossbauer fraction f of zero-
phonon gamma rays from dilute Co^{57} in Be and Cu were
obtained for several temperatures between liquid helium
and room temperature using the technique of the black
absorber. For Be at 297°K, f = 0.81; for Cu at 297°K,
f = 0.71. Systematic errors are estimated to be less
than 2%. The Mossbauer spectrum of Be shows a
quadrupole splitting $\Delta E = 0.56 \pm 0.03$ mm/sec and a
chemical shift $\delta = 0.11 \pm 0.03$ mm/sec with respect
to an Fe absorber. (Contractor's abstract)

2987

Wayne State U. [Dept. of Physics] Detroit, Mich.

LOW-TEMPERATURE ELASTIC MODULI OF ALUMI-
NUM, by G. N. Kamm and G. A. Alers. [1964] [4]p.
(AFOSR-64-1231) (AF AFOSR-62-379) AD 442807
                              Unclassified

Also published in Jour. Appl. Phys., v. 35: 327-330,
Feb. 1964.

The adiabatic elastic moduli of single crystals of
aluminum have been measured from 4.2° to 300°K by
using the ultrasonic pulse-echo technique. The values
obtained by extrapolation to 0°K are $C_{11} = 11.430$, C_{12}
= 6.192 and $C_{44} = 3.162$ in units of 10^{11} dyn/cm^2. The
Debye temperature obtained from the 0°K modulus
values is 430.3°K, in excellent agreement with the value
from heat-capacity measurements.

2988

Weizmann Inst. of Science, Rehovoth (Israel).

ANGULAR VARIATION OF COERCIVITY IN ORTHO-
FERRITE SINGLE CRYSTALS, by S. Reich, S.

Shtrikman, and D. Treves. Aug. 1, 1964, 24p. (Technical note no. 6) (AF 61(052)654) AD 605719
Unclassified

The coercive force Hc as a function of the angle between the easy axis of magnetization and the external field was studied in orthoferrite single crystals using the vibrating sample technique.

2989

Weizmann Inst. of Science, Rehovoth (Israel).

NONLINEARITY OF THE SUSCEPTIBILITY IN WEAK FERROMAGNETS AND ANTIFERROMAGNETS, by S. Shtrikman and D. Treves. Aug. 1, 1964, 7p. (Technical note no. 7) (AF 61(052)654) AD 605720
Unclassified

The symmetry of the tensor describing the quadratic dependence of the magnetization on an applied field is studied for the various magnetic point groups. It is described by at most one parameter in antiferromagnetic materials, and up to ten in ferromagnetic materials. This parameter is calculated from basic principles to various approximations for FeF_2 and CoF_2.

2990

Weizmann Inst. of Science, Rehovoth (Israel).

SPONTANEOUS MAGNETIZATION IN ORTHOFERRITES BETWEEN LIQUID AIR TEMPERATURE AND THE CURIE POINT, by G. Gorodetsky and D. Treves. Aug. 10, 1964, 16p. (Technical note no. 8) (AF 61-(052)654) AD 605721
Unclassified

Results of measurements of the ferromagnetic moment of rare earth orthoferrites between 90°K and the Curie point are presented. These results show that the rare earth ions behave like a paramagnet in an effective field due to the iron ions.

2991

Weizmann Inst. of Science, Rehovoth (Israel).

WEAK FERROMAGNETIC GAUSSMETER, by S. Shtrikman and D. Treves. Aug. 20, 1964, 10p. (Technical note no. 9) (AF 61(052)654) AD 605722
Unclassified

A torque magnetometer G. E. type gaussmeter using weak ferromagnetic rotors is described. Such an instrument gives a reading essentially linear with fields up to 100,000 gauss. The actual torques are higher than those obtained with para- or diamagnetic rotors, even at 100,000 gauss. An experimental instrument was built, and found to yield a linear reading up to the highest field available, i.e., 25 Kgauss.

2992

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

THE THREE BODY PROBLEM IN ATOMIC PHYSICS, by C. L. Pekeris. Final rept. Feb. 21, 1961- Feb. 20, 1963, 11p. incl. refs. (AFOSR-4577) (AF 61(052)510) AD 401373
Unclassified

This report gives several investigations in two- electron spectroscopy carried out during the two-year period of this contract.

2993

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

THE NUMERICAL INTEGRATION OF THE EQUATIONS OF MOTION OF A VISCOUS FLUID, by J. Gillis and A. Brandt. Oct. 1, 1964 [56]p. incl. diagrs. tables. (Scientific rept. no. 1) (AFOSR-65-0629) (AF EOAR-63-73) AD 614915
Unclassified

The steady state Navier-Stokes equations are solved numerically for the inlet region of a straight channel for values of Reynolds number from 0 to 500. Various properties of the flow are discussed and the results compared with previous approximate solutions for large R. The case R = 0 is also solved analytically. (Contractor's abstract)

2994

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

MECHANISM OF PHOTOPHOSPHORYLATION IN CHLOROPLASTS, by M. Avron. Final technical rept. May 26, 1963, 8p. (AFOSR-5254) (AF EOAR-62-59) AD 416428
Unclassified

The exchange between ADP and ATP found in chloroplasts was concluded to be unrelated to the process of photophosphorylation. Photophosphorylation coupled to the reduction of indophenol dyes was demonstrated. The complex role of indophenol dyes in inhibiting, eliciting, or bring about lag periods in photophosphorylation reactions was clarified. Previous studies on the path of oxygen atoms in photophosphorylation were extended. The effect of irradiating chloroplasts with uv light on their photochemical activity was studied. A sensitive method for measuring the reduction of ferricyanide in photochemical and other enzymatic reactions was developed. A factor which specifically restores the ability to phosphorylate, was isolated from chloroplasts.

2995

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

THE RELATION OF THE ADENOSINE 5'- TRIPHOSPHATE ADENOSINE 5'- DIPHOSPHATE EXCHANGE

ACTIVITY TO PHOTOPHOSPHORYLATION IN SWISS-
CHARD CHLOROPLASTS, by S. Ben-Yehoshus and
M. Avron. [1964] [7]p. (AFOSR-64-1177) (AF EOAR-
62-59) AD 442836   Unclassified

Also published in Biochim. et Biophys. Acta, v. 82:
67-73, 1964.

The presence of an enzyme-catalyzing ATP-ADP ex-
change in unwashed chloroplasts was confirmed. Chloro-
plast fragments from swiss-chard possessed little to
no ATP-ADP exchange activity while maintaining most
of the photophosphorylative activity of unwashed chloro-
plasts. The ATP-ADP exchange activity was com-
pletely recovered in the supernatants collected during
the preparation of chloroplast fragments from unwashed
chloroplasts. The possibility that the exchange activity
found in chloroplasts may be related to phosphoglycerate
kinase is discussed.

2996

Weizmann Inst. of Science. [Dept. of Biochemistry]
Rehovoth (Israel).

A COUPLING FACTOR IN PHOTOPHOSPHORYLATION,
by M. Avron. [1963] [13]p. (AFOSR-64-1178) (AF
EOAR-62-59) AD 442795   Unclassified

Also published in La Photosynthese; Colloques
Internationaux du Centre National de la Recherche
Scientifique, Gif-Sur-Yvette et Saclay, Paris (France)
(July 23-27, 1962). Paris, CNRS Pub. no. 119, 1963,
p. 543-555.

Chloroplasts or chloroplast fragments preincubated
with ethylenediamine-tetraacetate (EDTA) lose all their
photophosphorylative activity but not their electron
transport (Hill reaction) activity. The loss of photo-
phosphorylative activity is completely prevented by the
presence of salts with the EDTA. About 50% of the
photophosphorylative activity lost during a preincubation
with EDTA, can be reconstituted by a further prein-
cubation in the presence of magnesium ions. Chloro-
plast fragments which were isolated after a preincuba-
tion period with EDTA, then preincubation with mag-
nesium could be reconstituted to an extent of about 20%
only when the supernatant was also added.

2997

Weizmann Inst. of Science. [Dept. of Biochemistry]
Rehovoth (Israel).

A COUPLING FACTOR IN PHOTOPHOSPHORYLATION,
by M. Avron. [1963] [4]p. (AFOSR-64-1181)
(AF EOAR-62-59) AD 442992   Unclassified

Also published in Biochim. et Biophys. Acta, v. 77:
699-702, 1963.

The isolation from mitochondria of factors which were
necessary for phosphorylation but not for electron
transport in oxidative phosphorylation is discussed.
The experiments reported also demonstrate the isolation

of a similar factor from chloroplasts. The coupling
factor is required for photophosphorylation but not for
photoreduction.

2998

Weizmann Inst. of Science. [Dept. of Biochemistry]
Rehovoth (Israel).

A SENSITIVE AND SIMPLE METHOD FOR DETER-
MINATION OF FERROCYANIDE, by M. Avron and N.
Shavit. [1963] [6]p. (AFOSR-64-1184) (AF EOAR-62-
59) AD 442822   Unclassified

Also published in Anal. Biochem., v. 6: 549-554, Dec.
1963.

A simple assay for ferrocyanide is described which is
sensitive down to 0.001 μ mol. The method is suitable
for a direct assay of ferrocyanide, in the presence of
ferricyanide, in supernatants of trichloroacetic acid
denatured enzymic reactions.

2999

Weizmann Inst. of Science. [Dept. of Biochemistry]
Rehovoth (Israel).

ON THE COUPLING OF PHOTOPHOSPHORYLATION
TO ELECTRON TRANSPORT, by M. Avron and N.
Shavit. [1963] [8]p. (AFOSR-64-1185) (AF EOAR-62-
59) AD 442791   Unclassified

Also published in NAS-NRC Symposium on Photo-
synthesis Mechanisms in Green Plants, Publication
no. 1145, 1963, p. 611-618.

Several properties related to the coupling of photophos-
phorylation to electron transport in isolated chloro-
plasts from swiss-chard leaves and the effect of several
new and more potent uncouplers have been described.
Their differential effect on several photoreactions of
chloroplasts was interpreted as pointing to 2 separate
sites of ATP production in chloroplasts.

3000

Weizmann Inst. of Science. [Dept. of Biochemistry]
Rehovoth (Israel).

MECHANISM OF PHOTOPHOSPHORYLATION, by M.
Avron. Final rept. Apr. 30, 1964, 3p. (AFOSR-64-
1063) (AF EOAR-63-57) AD 441481   Unclassified

Several aspects of the mechanism of photophosphoryla-
tion were investigated. Photophosphorylation was
utilized as a tool for the synthesis of specifically P32
labeled ribonucleotides. Two types of light-dependent
ATPase were demonstrated. The role of indophenol
dyes in photophosphorylation reactions was clarified.
Several new inhibitors and uncouplers were investigated,
studies on a coupling factor from chloroplasts were
continued.

3001

Weizmann Inst. of Science. [Dept. of Biochemistry]
Rehovoth (Israel).

ON THE MECHANISM OF PHOTOPHOSPHORYLATION
IN CHLOROPLASTS, by M. Avron. [1964] [10]p. incl.
diagrs. tables, refs. (AFOSR-65-1299) (AF EOAR-
64-19) AD 620529   Unclassified

Also published in Record Chem. Prog., v. 25: 237-246,
Dec. 1964.

Recent investigations have demonstrated that the
mechanism of utilization of electron transport energy
to drive the esterification of ADP by inorganic phos-
phorus is similar, but not identical, in oxidative phos-
phorylation and photophosphorylation. Although the
general pattern of energy conversion reactions appears
to be similar, the difference in behavior and the differ-
ential sensitivity of the 2 systems to inhibitors and
uncouplers indicates that the intermediates involved are
different.

3002

Weizmann Inst. of Science. Dept. of Biophysics,
Rehovoth (Israel).

BIOLOGICAL SIGNIFICANCE OF HIGH MOLECULAR
WEIGHT POLYPEPTIDES, by E. Katchalski. Final
technical rept. Apr. 1, 1962-June 30, 1963, 21p. incl.
refs. (AFOSR-J1317) (AF EOAR-62-60) AD 424254
                                               Unclassified

A tritium-labeled poly-L-lysine, has been synthesized.
Experiments on the inactivation of coliphage T_2 with
an I^{131}-labeled copolymer of lysine and tyrosine
(molar residue ratio 30:1) have shown that the copolymer
enters the phage during the inactivation process. The
inactivated phage is still capable of injecting its DNA
together with the labeled polypeptide into the host cells
of Escherichia coli. New techniques for the preparation
of water-insoluble enzyme derivatives have been worked
out. Water- insoluble u. ease and ribonuclease deriva-
tives have been prepared. The mode of action of water-
insoluble ribonuclease on low and high molecular weight
substrates has been investigated. Membranes possess-
ing papain activity have been prepared with the aid of
bifunctional reagents such as bisdiazobenzidine. (Con-
tractor's abstract)

3003

Weizmann Inst. of Science. [Dept. of Biophysics]
Rehovoth (Israel).

BIOLOGICAL SIGNIFICANCE OF HIGH MOLECULAR
WEIGHT POLYPEPTIDES, by E. Katchalski. Final
technical rept. July 1, 1963-June 30, 1964, 23p.
(AFOSR-65-0281) (AF EOAR-63-59) AD 611185
                                               Unclassified

Summaries of research conducted on the following 3
topics are presented: (1) Use of polyamino acids in
the study of cell membranes; (2) Interaction of poly-

amino acids with viruses; and (3) Preparation and
characterization of water-insoluble enzyme derivatives.

3004

Weizmann Inst. of Science. Dept. of Physics,
Rehovoth (Israel).

USE OF POLY-ALPHA-ACIDS IN BIOLOGICAL STUDIES,
by E. Katchalski. [1964] [18]p. incl. illus. diagrs.
table, refs. (AFOSR-65-2170) (AF EOAR-63-59)
AD 627485   Unclassified

Also published in New Perspectives in Biology, ed. by
M Sci., Amsterdam, Elsevier Publishing Co., 1964,
p. 51-68.

A description of the synthesis of high molecular weight
polypeptides is presented. A group of synthetic poly-
mers (poly-L-proline, poly-L-glutamic acid, and poly-
L-lysine) were found useful as model compounds in the
study of proteins. The data already available indicate
that these synthetic polypeptides may be of considerable
value in the elucidation of the mode of action of known
proteolytic enzymes, in the search for new proteolytic
enzymes, and in the clarification of the inhibition of
enzymes by macromolecules. The close resemblance
between the antibacterial and antiviral properties of
basic polyamino acids with those of some natural peptides
indicates that both the synthetic model compounds and
the natural materials may act biologically by a similar
mechanism. Also promising are the results obtained in
the investigation of the immunological properties of
synthetic polyamino acids and of polypeptidyl proteins,
since they may contribute to an understanding of the
chemical basis of the antigenicity of proteins.

3005

Weizmann Inst. of Science. Dept. of Biophysics,
Rehovoth (Israel).

SYNTHESIS OF TRITIATED POLY-L-LYSINE ($\gamma, \delta - T_2$),
by M. Fridkin, M. Sokolovsky, and E. Katchalski.
[1964] [7]p. incl. refs. (AFOSR-65-2172) (AF EOAR-
63-59) AD 629294   Unclassified

Also published in Biopolymers, v. 2: 123-129, 1964.

Tritiated poly-L-lysine ($\gamma, \delta - T_2$) (I) was prepared
according to the following procedure: Tritiated Dl-
lysine ($\gamma, \delta - T_2$) was derived from acetamino-(4-amino-
Δ^2-butenyl)-diethylmalonate by tritiation followed by
acid hydrolysis. The racemic tritiated lysine was con-
verted to its ϵ, N-trifluoroacetyl derivative, and the
latter resolved via its chloroacetyl derivative by means
of hog kidney acylase. The optically active tritiated
ϵ, N-trifluoroacetyl-L-lysine was converted into the
corresponding N-carboxyanhydride with phosgene, and
polymerization carried out in dioxane using triethyl-
amine as initiator. The required tritiated poly-L-lysine
(i, n = 250) was obtained from the blocked polymer after
removal of the protecting groups with piperidine. The
tritiated polypeptide possessed an activity of 250
mC/mmol lysine residue. The procedure described

enables, however, the preparation of poly-L-lysine with up to 25 times higher specific activity. (Contractor's abstract)

3006

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

PREPARATION ADD PROPERTIES OF WATER-INSOLUBLE DERIVATIVES OF UREASE, by E. Riesel and E. Katchalski. [1964] [4]p. incl. diagr. table, refs. (AFOSR-65-2173) (AF EOAR-63-59) AD 627486
Unclassified

Also published in Jour. Biol. Chem., v. 239: 1521-1524, May 1964.

Water-insoluble urease preparations were obtained by coupling unmodified urease, or urease reversibly inactivated with p-chloromercuribenzoate, with a water-insoluble diazonium salt derived from a copolymer of p-amino-DL-phenylalanine and L-leucine. The enzymatic activity of the insoluble preparations derived from inactivated urease was determined after reactivation with cysteine. All of the insoluble derivatives obtained, which contained 15 to 60 mg of protein per 100 mg of water-insoluble enzyme, displayed after preparation an enzymatic activity, per unit of weight of bound protein, corresponding to about half of that of the original urease preparation used in the coupling reaction.

3007

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

A WATER-INSOLUBLE POLYANIONIC DERIVATIVE OF TRYPSIN. II. EFFECT OF THE POLYELECTROLYTE CARRIER ON THE KINETIC BEHAVIOR OF THE BOUND TRYPSIN, by L. Goldstein, Y. Levin, and E. Katchalski. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-66-0291) (AF EOAR-63-59) AD 639506
Unclassified

Also published in Biochemistry, v. 3: 1913-1919, Dec. 1964.

The mode of action of the water-insoluble derivatives of trypsin (IMET), obtained by the covalent binding of trypsin to a copolymer of maleic acid and ethylene (1:1), has been investigated at 25°C. The pH-activity profile of IMET at low ionic strength, using benzoyl-L-arginine ethyl ester as substrate, was found to be displaced by approximately 2.5 pH units toward more alkaline pH values when compared with trypsin under similar conditions. At higher ionic strength, the pH-activity curve of IMET shifted toward more acid pH values, approaching the pH-activity curve of IMET-trypsin. Theoretical analysis of the kinetic data allowed a quantitative correlation of the displacement in the pH-activity curves and the shifts in the Michaelis constants with the electrostatic potential prevailing in the domain of the polyelectrolyte carrier. (Contractor's abstract, modified)

3008

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

A WATER-INSOLUBLE POLYANIONIC DERIVATIVE OF TRYPSIN. I. PREPARATION AND PROPERTIES, by Y. Levin, M. Pecht and others. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-66-0293) (AF EOAR-63-59) AD 633330
Unclassified

Also published in Biochemistry, v. 3: 1905-1913, Dec. 1964.

A number of water-insoluble polyanionic derivatives of trypsin (IMET) were prepared by coupling the enzyme to a copolymer of maleic anhydride and ethylene, cross-linking with hexamethylenediamine, and hydrolyzing the unreacted maleic anhydride residues. Different IMET preparations with varying bound protein-to-carrier ratios (from 1:20 to 3:1) were obtained. Their esteratic activities per unit weight of bound protein corresponded to 40-70% of that of crystalline trypsin. All of the IMET preparations studied were found to be considerably more stable than trypsin in the alkaline pH range (pH7.0-10.7 10.7). Practically no inhibition of the esteratic activity by soybean-trypsin inhibitor occurred even at a 50:1 weight ratio of inhibitor to bound enzyme protein. The soybean-trypsin inhibitor was found, however, to be an effective inhibitor of the proteolytic activity of the IMET's as tested on casein. The pH-activity profiles of an IMET preparation rich in carrier (IMET-1) and of an IMET preparation rich in protein (IMET-6) at different ionic strengths were determined. (Contractor's abstract, modified)

3009

Weizmann Inst. of Science. [Dept. of Biophysics] Rehovoth (Israel).

IMMUNE RESPONSE TO POLYPEPTIDYL PROTEINS IN RABBITS TOLERANT TO THE PROTEIN CARRIERS, by I. Schechter, S. Bauminger and others. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-65-1300) (AF EOAR-64-22) AD 620593
Unclassified

Also published in Immunochemistry, v. 1: 249-265, 1964.

A study was made of the immune responses to polypeptidyl proteins in rabbits which were either naturally tolerant or made experimentally unresponsive to the protein carriers. Experimentally acquired tolerance to HSA human serum albumin could be terminated by immunization of the unresponsive rabbits with poly-L-tyrosyl derivatives of HSA. Two parameters determined the breakdown of tolerance: (1) the chemical nature of the peptides attached: polytyrosyl HSA was effective in the termination of tolerance to HSA, whereas polyalanyl HSA was not, and (2) the degree of enrichment with tyrosine. There appears to be an optimal degree of enrichment, i.e., of molecular alteration of the HSA, which will confer on the altered antigen the maximal potency to terminate tolerance. The level of tolerance breakdown obtained by polytyrosyl HSA, as measured by the ratio of anti-HSA/anti-polytyrosyl

HSA, was greater than the level obtained previously by other chemically altered antigens. Antibodies were produced to the peptides per se, when attached to proteins towards which the animal is naturally tolerant, or to proteins to which the animal has acquired tolerance (HSA). In both systems, there was a similar pattern of antibody formation, which may reflect a similarity in mechanism between natural and actively acquired tolerance. (Contractor's abstract, modified)

3010

Weizmann Inst. of Science. [Dept. of Biophysics] Rehovoth (Israel).

INDUCTION OF IMMUNOLOGICAL TOLERANCE TOWARDS A PEPTIDE DETERMINANT WITH A NON-IMMUNOGENIC POLYPEPTIDE, by I. Schechter, S. Bauminger, and M. Sela. [1964] [2]p. incl. table, refs. (AFOSR-65-1301) (AF EOAR-64-22) AD 620632   Unclassified

Also published in Biochim. et Biophys. Acta, v. 93: 686-687, 1964.

Newborn rabbits were injected intraperitoneally with multi-chain poly-DL-alanine within 24 hr after birth, 7 days later, and at 2 months. At 90, 104, and 128 days, the animals of the control and the test groups were challenged with an immunizing dose of 15 mg of either poly-DL-alanyl human serum albumin or poly-DL-alanyl ribonuclease in complete Freund's adjuvant. Fourteen days after the third injection the animals were bled and tested for immune response by precipitin reaction. None of the test animals showed antibodies reacting with multi-chain poly-DL-alanine; the control animals, however, formed antibodies, almost all of which reacted with the multi-chain poly-DL-alanine; It is concluded that a substance must not be immunogenic in order to induce tolerance.

3011

Weizmann Inst. of Science. [Dept. of Physics] Rehovoth (Israel).

MOMENTS OF INERTIA AND THE SHELL MODEL, by C. A. Levinson. [1963] [5]p. incl. diagrs. (AFOSR-64-0862) (AF 61(052)337) AD 438647   Unclassified

Also published in Phys. Rev., v. 132: 2184-2188, Dec. 1, 1963.

The variational formula of Skyrme for the moment of inertia is analyzed in some detail. The errors in this formula are studied and an upper bound is given. It is found that in the case of the shell model this approach is quite accurate and allows use of general Hamiltonians. (Contractor's abstract)

3012

Weizmann Inst. of Science. [Dept. of Physics] Rehovoth (Israel).

VARIATIONAL SHELL-MODEL METHODS FOR DEFORMED ORBITALS, by I. Kelson. [1963] [5]p. incl. diagrs. tables, refs. (AFOSR-64-0863) (AF 61(052)-337) AD 438648   Unclassified

Also published in Phys. Rev., v. 132: 2189-2193, Dec. 1, 1963.

A single-particle representation of deformed orbitals in the s-d shell is obtained by using variational self-consistent methods. The 2-body Rosenfeld potential is taken as the effective interaction. The dependence of the single-particle Hamiltonian on the force parameters as well as its dependence on the number of nucleons, is investigated. The results are compared with the deformed harmonic-oscillator model. (Contractor's abstract)

3013

Weizmann Inst. of Science. Polymer Dept., Rehovoth (Israel).

MECHANOCHEMISTRY OF COUPLED CONTRACTILE AND CHEMICAL RATE PROCESSES, by A. Katchalsky. Final rept. Jan. 1964, 188p. incl. diagrs. tables, refs. (AFOSR-64-0393) (AF EOAR-62-58) AD 600541   Unclassified

This work is based on the realization that efficient conversion of chemical into mechanical energy can be based on macromolecular systems of the type encountered in living mechanochemical systems, such as muscles, flagella or contractile membranes. First the general properties of swollen polymeric fibers or bands which retain their rigidity and useful elastic properties even at high degrees of swelling were studied. The behavior of cross-linked and swollen rubbers were studied in detail. The energetic parameters of interaction between the contractile gel and the added reagent were evaluated. It was found that some of the classical notions of rubber behavior could be applied to swollen rubbers. It was found that very suitable mechanochemical engines could be prepared from partially cross-linked collagen fibers and strands.

3014

Western Ontario U. Dept. of Physics, London (Canada).

RESEARCH ON GAS SCINTILLATIONS FROM IONISING RADIATIONS, by R. W. Nicholls. Final technical rept. June 1, 1961-May 31, 1962 [17]p. incl. tables, refs. (AFOSR-2935) (AF AFOSR-61-88) AD 277801   Unclassified

The experimental and theoretical research performed during the grant year is reviewed. Studies were made on: Intensity Measurements of Molecular Spectra; Identification Atlas of Molecular Spectra; Ion Beam Spectroscopy, Plasma-Jet Spectroscopy; Corona

Spectroscopy; Molecular Potentials; Vibrational Wave Functions; Franck-Condon Factors; r-Centroids; Vibrational-Rotation Interaction; and Atomic Collisions. (Contractor's abstract)

3015

Western Ontario U. Dept. of Physics, London (Canada).

A RACETRACK MICROTRON FOR MILLIMETER AND SUBMILLIMETER WAVE GENERATION, by H. Froelich and E. Brannen. [1963] [4]p. incl. illus. diagrs. (AFOSR-4816) (AF AFOSR-62-172) AD 412672
Unclassified

Also published in IEEE Trans. Microwave Theory and Tech., v. MIT-11: 288-291, Sept. 1963.

The accelerator described here is an eight-orbit four-sector racetrack microtron possessing strong focusing action. The magnet gap is only 7 mm, and the accelerating cavity is placed in one of the field-free regions. The energy gain per traversal of the cavity can be varied from 0.4 to 1.5 mev and synchronism obtained by adjustment of the magnetic field strength and the length of the main straight section. A theoretical analysis of the synchrotron oscillations in energy and phase shows that tight bunching can be achieved at almost any point in any desired orbit by changing the frequency of the synchrotron oscillations. This can be accomplished by varying the RF power and therefore the accelerating voltage. (Contractor's abstract, modified)

3016

Western Ontario U. Dept. of Physics, London (Canada).

MILLIMETER ELECTROMAGNETIC RADIATION PRODUCED BY HIGH ENERGY ELECTRON BEAMS, by E. Brannen. Final rept. Nov. 1, 1961-Jan. 31, 1963, 9p. (AFOSR-64-0271) (AF AFOSR-62-172) AD 431119
Unclassified

The central problem studied was the generation of millimeter and sub-millimeter waves with bunched megavolt electron beams, through the interaction with Cerenkov and transition radiators. An experimental study of the latter as a function of hole size was carried out, the highest radiation resistance being 100 ohms. Most emphasis was placed on the development and theoretical analysis of the racetrack microtron as a source of a bunched electron beam. It was shown that tight bunching could be achieved at any position in any orbit by appropriate adjustment of the microtron's operating conditions (magnetic field, energy gain per traversal and length of straight section). (Contractor's abstract, modified)

3017

Western Ontario U. [Dept. of Physics] London (Canada).

A RESEARCH PROGRAMME ON LABORATORY

ASTROPHYSICS, by R. W. Nicholls and H. I. S. Ferguson. 1963, 22p. (AFOSR-4804) (AF AFOSR-62-236) AD 414437
Unclassified

Contemporary problems of atmospheric physics, space physics, meteor and re-entry physics and propulsion, require more basic data of atomic and molecular physics than is currently available. Research in the general field of Laboratory Astrophysics supplies such basic data. Current activities on the research program in Laboratory Astrophysics at the University of Western Ontario are reviewed.

3018

Western Ontario U. [Dept. of Physics] London (Canada).

LABORATORY ASTROPHYSICS AND COMBUSTION, by R. W. Nicholls. 1963, 31p. (AFOSR-4805) (AF AFOSR-62-236) AD 414438
Unclassified

The similarities between the methods and concepts of astrophysics and of quantitative combustion spectroscopy are discussed with special reference to radiative properties of hot gases. New transition probability data are presented and discussed for the CN Violet, CN Red, C2 Swan, OH Violet band system.

3019

Western Ontario U. Dept. of Physics, London (Canada).

THE SPECTROSCOPY OF SHOCK-EXCITED POWDERED SOLIDS, by R. W. Nicholls, W. H. Parkinson, and E. M. Reeves. [1963] [12]p. incl. illus. diagr. tables, refs. (AFOSR-4806) (AF AFOSR-62-236) AD 414436
Unclassified

Also published in Appl. Opt., v. 2: 919-930, Sept. 1963.

The shock tube is shown to be an excellent spectroscopic source for controlled thermal excitation of astrophysically interesting spectra. Spectroscopic studies of the luminosity from shock-excited powdered solids made in 3 laboratories during the past 7 yr are discussed in detail. A wide range of inorganic oxides, nitrides, hydrides, carbides, and sulfides and other compounds have been treated in addition to samples of meteorite. A few aromatic organic materials have also been studied. Time-resolved emission and absorption techniques have been used. Spectra of most inorganic materials change from molecular to atomic with increase in shock Mach number, and an over-all thermal excitation mechanism appears to be most probable. The situation with organic materials, which have lower melting points, appears to be more complex. (Contractor's abstract)

3020

Western Ontario U. [Dept. of Physics] London (Canada).

ELECTRONIC TRANSITION MOMENTS AND THEIR EFFECTS ON THE BAND STRENGTHS AND ABSORPTION OSCILLATOR STRENGTHS OF THE NO β AND γ

SYSTEMS, by G. V. Marr. [1964] [8]p. incl. diagr.
tables, refs. (AFOSR-64-0807) (AF AFOSR-62-236)
AD 438374　　　　　　　　　　　Unclassified

Also published in Proc. Phys. Soc. (London), v. 83:
283-300, 1964.

The variation of the electronic transition moment with
internuclear separation for the NO β (B $^2\Pi$-x $^2\Pi$) and
NO γ (A $^2\Sigma^+$-x $^2\Pi$) systems inferred from available
intensity measurements is used to evaluate band
strengths and band absorption oscillator strengths. It
is doubtful whether the concept of an electronic oscil-
lator strength for the whole system is meaningful for
these transitions. (Contractor's abstract)

3021

Western Ontario U. Dept. of Physics, London (Canada).

INTERPOLATION OF FRANCK-CONDON FACTORS,
by R. W. Nicholls. [1964] [1]p. (AFOSR-65-1085)
(AF AFOSR-62-236) AD 619362　　　Unclassified

Also published in Nature, v. 204: 373, Oct. 24, 1964.

Magnitude estimates of Franck-Condon factors, $q_{v'v''}$
may be used for definitive identification of molecular
bands or band systems, or for estimates of radiative
heat transfer from hot gases. An interpolation of $q_{v'v''}$
arrays, which have already been calculated, allows
a simple means of making such estimates. A transition
parameter t which varies from band to band and which
may be used for interpolation is therefore required in
order that plots of $q_{v'v''}$ vs t can be made for each band
of interest. The method of deriving an approximation
for t is shown.

3022

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS TO HIGH VIBRATIONAL
QUANTUM NUMBERS III: CN, by R. W. Nicholls.
[1964] [4]p. incl. diagrs. tables, refs. (AFOSR-65-
1087) (AF AFOSR-62-236) AD 622906　Unclassified

Also published in Jour. Research Nat'l. Bur. Stand.,
v. 68A: 75-78, Jan.-Feb. 1964.

Franck-Condon factor arrays are computed numerically
to high vibrational quantum numbers for the red
(A $^2\Pi_i$ — X $^2\Sigma^+$) and violet (B $^2\Sigma^+$ — X $^2\Sigma^+$(band systems
of CN. The method used is the straightforward numer-
ical method of computation for Morse molecules.
(Contractor's abstract, modified)

3023

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS TO HIGH VIBRATIONAL
QUANTUM NUMBERS IV: NO BAND SYSTEMS, by

R. W. Nicholls. [1964] [6]p. incl. diagr. tables, refs.
(AFOSR-65-1088) (AF AFOSR-62-236) AD 619137
　　　　　　　　　　　　　　　　Unclassified

Also published in Jour. Research Nat'l. Bur. Stand.,
v. 68A: 535-540, Sept.-Oct. 1964.

Franck-Condon factor arrays have been computed
numerically to highest known vibrational quantum num-
bers for the following NO band systems.

β (B $^2\Pi$ - X $^2\Pi$)	Feast 1 (D $^2\Sigma^+$ - A $^2\Sigma^+$)
γ (A $^2\Sigma^+$ - X $^2\Pi$)	Feast 2 (E $^2\Sigma^+$ - A $^2\Sigma^+$)
δ (C $^2\Pi$ - X $^2\Pi$)	Ogawa 1 (B $'^2\Delta$ - B $^2\Pi$)
ϵ (D $^2\Sigma^+$ - X $^2\Pi$)	Ogawa 2 (b $^4\Sigma^-$ - a $^4\Pi$)
β (B $'^2\Delta$ - X $^2\Pi$)	"M" (a $^4\Pi$ - X ^{2}-Π)
γ (E $^2\Sigma^+$ - X $^2\Pi$)	

(Contractor's abstract)

3024

Western Ontario U. Dept. of Physics, London (Canada).

TRANSITION PROBABILITIES OF AERONOMICALLY
IMPORTANT SPECTRA, by R. W. Nicholls. [1964]
[38]p. incl. diagrs. tables, refs. (AFOSR-65-1089)
(AF AFOSR-62-236) AD 618286　　　Unclassified

Also published in Ann. Geophys., v. 20: 144-181,
Apr.-June 1964.

Atomic and molecular radiative transitions which are
important in aeronomy are reviewed. The various
transition probability parameters of atomic and molecu-
lar spectra are defined and the currently available
values of transition probabilities of the aeronomical
spectra are displayed in tables. (Contractor's abstract)

3025

Western Ontario U. [Dept. of Physics] London (Canada).

THE ELECTRONIC TRANSITION MOMENT OF THE
A $^2\Sigma$ - X $^2\Sigma$ SYSTEM OF AlO, by D. C. Tyte and G. R.
Hebert. [1964] [3]p. incl. table. (AFOSR-65-1090)
(AF AFOSR-62-236) AD 618283　　　Unclassified

Also published in Proc. Phys. Soc. (London), v. 84:
830-832, 1964.

Photographic intensity measurements have been made
on the A $^2\Sigma$ - X $^2\Sigma$ system of AlO excited in a shock tube
and by exploding an Al foil. The electronic transition
moment was found to have the form $R_e(r)$ = const (1 -
0.46r). This result confirms that previously reported
by Hebert and Tyte for the system excited in an ac arc.
(Contractor's abstract)

3026

Western Ontario U. Dept. of Physics, London (Canada).

INTENSITY MEASUREMENTS ON THE A $^2\Sigma$ - X $^2\Sigma$

SYSTEM OF ALUMINUM OXIDE, by G. R. Hébert and D. C. Tyte. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-1091) (AF AFOSR-62-236) AD 618284
Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 629-634, 1964.

Relative integrated band intensities of 29 bands of the blue-green system of aluminum oxide, excited in a low pressure arc, have been measured by photographic photometry. The electronic transition moment was found to have the form $R_e(r) = $ const $(1-0.46 r)$; $1.50 A < r < 1.85 A$. Smoothed relative transition probabilities have been derived for the bands. (Contractor's abstract)

3027

Western Ontario U. [Dept. of Physics] London (Canada).

A THEORETICAL STUDY OF THE $O_2 X\ ^3\Sigma_g^- - B\ ^3\Sigma_u^-$ PHOTODISSOCIATION CONTINUUM, by W. R. Jarmain and R. W. Nicholls. [1964] [8]p. incl. diagrs. table, refs. (AFOSR-65-1093) (AF AFOSR-62-236) AD 618188
Unclassified

Also published in Proc. Phys. Soc. (London), v. 84: 417-424, 1964.

Franck-Condon densities, $q_{v,v''} = |\int \psi_v(r)\ \psi_{v''}(r)dr|^2$, for $v'' = 0$ in the O_2 Schumann-Runge photodissociation continuum have been calculated for realistic Klein-Dunham potentials. They are combined with measured values of the absorption coefficient to study the variation of the electronic transition moment in the continuum. For comparison, Franck-Condon factors have similarly been used in conjunction with measured oscillator strengths to show the behavior of the transition moment for the $v'' = 0$ progression of bands. It appears probable that the transition moment is continuous through the dissociation limit. (Contractor's abstract)

3028

Western Ontario U. [Dept. of Physics] London (Canada).

LABORATORY ASTROPHYSICS AND SPACE SCIENCE, by R. W. Nicholls and H. I. S. Ferguson. [1964] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1094) (AF AFOSR-62-236) AD 620708
Unclassified

Also published in Canad. Aeronaut. and Space Jour., v. 10: 163-168, June 1964.

Contemporary problems of space physics, atmospheric physics, meteor and reentry physics, and propulsion require for their solution much more of the basic data of atomic, molecular, and nuclear physics and chemistry than are currently available. Research in the general field of laboratory astrophysics supplies such basic data. Some of the current activities of the research program in laboratory astrophysics at the University of Western Ontario are reviewed. Included are spectroscopic studies on important diatomic molec-

ular spectra, studies of shock excitation of powdered solids, and ablation and impact flash studies in a ballistic pellet range. (Contractor's abstract, modified)

3029

Western Ontario U. Dept. of Physics, London (Canada).

IDENTIFICATION ATLAS OF MOLECULAR SPECTRA. I. THE AlO $A^2\Sigma - X^2\Sigma$ BLUE-GREEN SYSTEM, by D. C. Tyte and R. W. Nicholls. Mar. 10, 1964, 13p. incl. illus. diagrs. tables, refs. (AFOSR-65-2315) (AF AFOSR-62-236) AD 627556
Unclassified

This report contains a set of vibrationally identified spectrograms of the Blue-Green (A $^2\Sigma$ - X $^2\Sigma$) system of AlO. A compilation of all the available molecular data on the states involved, a brief description of the appearance, occurrence and history of the system and a selected bibliography are also included. (Contractor's abstract)

3030

Western Ontario U. Dept. of Physics, London (Canada).

IDENTIFICATION ATLAS OF MOLECULAR SPECTRA. II. THE $N_2\ C^3\Pi_u - B\ ^3\Pi_g$ SECOND POSITIVE SYSTEM, by D. C. Tyte and R. W. Nicholls. Oct. 31, 1964, 17p. incl. illus. diagrs. tables, refs. (AFOSR-65-2316) (AF AFOSR-62-236) AD 627814
Unclassified

This report contains a set of vibrationally identified spectrograms of the Second Positive (C $^3\Pi_u$-B $^3\Pi_g$) system of N_2. A compilation of all the available molecular data on the states involved, a brief description of the appearance, occurrence and history of the system and a selected bibliography are also included. (Contractor's abstract)

3031

Western Ontario U. Dept. of Physics, London (Canada).

THEORY AND DESIGN OF A RACE-TRACE MICROTRON WITH APPLICATION TO THE GENERATION OF MILLIMETER WAVES, by H. R. Froelich and E. Brannen. Dec. 1964, 117p. incl. illus. diagrs. refs. (Technical rept. no. RMG-T-1) (AFOSR-65-1626) (AF AFOSR-63-297) AD 623802
Unclassified

The race-trace microtron treated is a 4-sector design with homogeneous magnetic fields in the sectors. Synchronism and phase stability are investigated for an energy gain that is variable from 0.5 to 1.0 mev. Stability of betatron oscillations is examined using the "hard-edge" approximation for the shape of the magnetic field. The design of a race-trace microtron is described, whose basic feature is its adaptability to different pole-piece arrangements. Beam bunching in a microtron permits its application to the generation of millimeter and submillimeter waves. The mechanism causing beam bunching is investigated theoretically. Generation of 8 mm waves using the beam of a conventional microtron is described. (Contractor's abstract)

3032

Western Reserve U. Center for Documentation and
Communication Research, Cleveland, Ohio.

INFORMATION RETRIEVAL AT WESTERN RESERVE
UNIVERSITY, by J. Belzer. [1963] [5]p. (AFOSR-
J482) (AF AFOSR-62-35) AD 407254   Unclassified

Also published in Elektron. Datenverabeitung, v. 1:
4-8, 1963.

The manager of the computation department of the
Center for Documentation and Communication Research,
Western Reserve University, reports on the informa-
tion retrieval works at the center. The general develop-
ment, as well as the special research of the center, is
described.

3033

Western Reserve U. Center for Documentation and
Communication Research, Cleveland, Ohio.

A SEARCHING PROCEDURE FOR INFORMATION
RETRIEVAL, by W. Goffman. [1964] [6]p. (AFOSR-
64-2262) (AF AFOSR-63-403) AD 452528
                                    Unclassified

Also published in Inform. Storage and Retrieval, v. 2:
75-78, 1964.

A search procedure for an information retrieval system
is developed whereby the answer to a question is ob-
tained by maximizing an evaluation function of the sys-
tem's output in terms of the probability of relevance.
Necessary and sufficient conditions are given for a set
to be an answer to a query. A partition of the file is
made in such a way that all documents belonging to the
answer are members of the same class. Hence, the
answer can be generated by one relevant document. In
this manner, a search of the total file is avoided.

3034

Western Reserve U. Center for Documentation and
Communication Research, Cleveland, Ohio.

METHODOLOGY FOR TEST AND EVALUATION OF
INFORMATION RETRIEVAL SYSTEMS, by W. Goffman
and V. A. Newill. July 1964, 19p. incl. diagrs. table,
refs. (Rept. no. CSL: TR-2) (AFOSR-65-0587)
(AF AFOSR-63-403) AD 614005   Unclassified

Also published in Inform. Storage and Retrieval, v. 3:
19-25, 1966.

Information retrieval systems are discussed in terms
of their purpose and function. The essential compo-
nents of an information retrieval system are defined.
A methodology for evaluating the comparative per-
formance of systems is developed. Specific measures
and methods of analysis of results are presented.
(Contractor's abstract)

3035

Western Reserve U. Center for Documentation and
Communication Research, Cleveland, Ohio.

GENERALIZATION OF EPIDEMIC THEORY. AN
APPLICATION TO THE TRANSMISSION OF IDEAS, by
W. Goffman and V. A. Newill. [1964] [4]p. incl. table.
(AFOSR-65-0588) (AF AFOSR-64-403) AD 614744
                                     Unclassified

Also published in Nature, v. 204: 225-228, Oct. 17,
1964.

A basic problem concerning information retrieval is
that of determining circumstances under which it might
be necessary to introduce an information retrieval sys-
tem as an aid to a given population of scientists. It is
proposed that this problem be examined in terms of the
transmission and development of ideas within a popula-
tion. Specifically, the transmission of ideas within a
population will be treated as if it were the transmission
of an infectious disease, i. e., in terms of an epidemic
process. An attempt is made to indicate the role of
information retrieval in the development of such a
process.

3036

Western Reserve U. Center for Documentation and
Communication Research, Cleveland, Ohio.

ON RELEVANCE AS A MEASURE, by W. Goffman.
[1964] [3]p. (AFOSR-65-0589) (AF AFOSR-64-403)
AD 615046   Unclassified

Also published in Inform. Storage and Retrieval, v. 2:
201-20", 1964.

Relevance is defined as a measure of information con-
veyed by a document, i. e., a set of words conveying
information, relative to a query, i. e., a set of words
requesting information. Any measure of information
must depend on what is already known a fact which
must be recognized in any assessment of the relevance
of a document with respect to a query. In this note it
is shown that the relationship between a document and
a query is necessary but not sufficient to determine
relevance.

3037

Western Reserve U. Center for Documentation and
Communication Research, Cleveland, Ohio.

USE OF META-LANGUAGE IN INFORMATION RE-
TRIEVAL SYSTEMS, by W. Goffman, J. Verhoeff, and
J. Belzer. [1964] [9]p. incl. diagrs. (AFOSR-65-
1520) (AF AFOSR-63-403) AD 625577   Unclassified

Also published in Amer. Doc., v. 15: 14-22, Jan. 1964.

The usefulness of meta-language, a language used to
talk about another language, called the object language,
is discussed as it relates to information retrieval sys-
tems. The general meta-language concept is explained

and information retrieval ystems reviewed. The role of meta-language in documentation is then dealt with. It is felt that for maximum performance from an information retrieval system, the question posed to a system must be in a meta-language and the documents within the system indexed accordingly.

3038

Western Reserve U. [School of Medicine] Cleveland, Ohio.

[VASOPRESSIN BIOSYNTHESIS] Final rept. Feb. 1963, 4p. (AFOSR-4711) (AF 49(638)764) AD 408657
Unclassified

Scientific research on vasopressin is presented in summary form and a list of the other publication- for this contract is included.

3039

Western Reserve U. School of Medicine, Cleveland, Ohio.

NEURAL PATHS AND INTEGRATION CENTERS FOR ACTH AND ADH RELEASE, by G. Sayers. Final rept. Apr. 16, 1962-Apr. 15, 1963, 6p. (AFOSR-64-0546) (AF AFOSR-62-3) AD 435910   Unclassified

This work was concerned with neural pathways to the hypothalamus mediating ACTH release. A neural pathway through spinal cord appears essential for ACTH release in response to cutaneous electrical stimulation. Spinal cord transection in the rat at the level of the upper thoracic vertebrae prevents adrenal ascorbic acid depletion following electric shock to the lower extremities. Stimulation of the forelegs of the cord-sectioned rat elicits ACTH release. The relative importance of locally produced toxins and of neural connections in the mediation of ACTH release in response to burns and to operative trauma has been evaluated. There is no evidence for the production in the wounded area of a substance which induces ACTH release from the adenohypophysis. The peripheral nerves appear to play the major role.

3040

Western Reserve U. [School of Medicine] Cleveland, Ohio.

[VASOPRESSIN BIOSYNTHESIS] Final rept. Feb. 1963-Oct. 1964, 3p. (AFOSR-65-0282) (AF AFOSR-63-408) AD 611185   Unclassified

The objectives of the research were to study in vivo and in vitro a number of processes concerned with the biosynthesis, storage, and release of vasopressin. Previous experimental data suggested the possibility that the biosynthesis of vasopressin occurs in a bound, biologically inactive form and that the release of hormone takes place during the formation and maturation of the neurosecretory particles. Data have now been obtained which are consistent with such a 'precursor model' for vasopressin biosynthesis. The in vitro systems, capable of carrying out the biosynthesis and release of vasopressin, offer a considerable number

of possibilities for studies concerned with the nuerosecretory process.

3041

Western Reserve U. School of Medicine, Cleveland, Ohio.

VASOPRESSIN BIOSYNTHESIS. III. IN VITRO STUDIES, by Y. Takabatake and H. Sachs. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0301) (AF AFOSR-63-408) AD 611894   Unclassified

Also published in Endocrinology, v. 75: 934-942, Dec. 1964.

Under appropriate conditions, the hypothalamo-neurohypophysial complex, removed intact from guinea pigs, incorporated ^{35}S-cysteine or ^{3}H-tyrosine into vasopressin and tissue proteins. The appearance of labeled hormone was time-dependent, required an energy source and was inhibited by puromycin. Whereas slices of hypothalamic-median eminence (HME) tissue could also carry out the incorporation of isotopic amino acids into vasopressin in vitro, the distal portion of the neuron could not do so. (Contractor's abstract, modified)

3042

Western Reserve U. School of Medicine, Cleveland, Ohio.

EVIDENCE FOR A PRECURSOR IN VASOPRESSIN BIOSYNTHESIS, by H. Sachs and Y. Takabatake. [1964] [6]p. incl. diagr. tables, refs. (AFOSR-65-0302) (AF AFOSR-63-408) AD 611893   Unclassified

Also published in Endocrinology, v. 5: 943-948, Dec. 1964.

Infusion of ^{35}S-cysteine into the third ventricle of dogs for a period of 1.5 hr did not yield significant quantities of labeled vasopressin. However, animals sacrificed 4.5 hr after 1.5 hr of isotope infusion yielded ^{35}S-vasopressin. If puromycin was administered from the start of the experiment, then labeling of vasopressin was not observed. Puromycin, administered after the isotope had been infused, did not prevent the subsequent appearance of labeled hormone either in vivo or with hypothalamic-median eminence (HME) slices incubated in vitro. The HME slices, in the presence of puromycin, gave rise to ^{35}S- or ^{3}H-vasopressin only if the in vitro incubation was preceded by the infusion of ^{35}S-cysteine or ^{3}H-tyrosine, respectively, into the third ventricle of a dog for 1.5 hr prior to sacrifice. (Contractor's abstract, modified)

3043

[Westinghouse Electric Corp.] Baltimore, Md.

CELESTIAL MECHANICS RESEARCH, by G. Shapiro and E. W. Paul. Final rept. Jan. 28, 1964. 30p. incl. refs. (AFOSR-64-0132) (AF 49(638)1002) AD 434412
Unclassified

In order to examine the effect in lead of the residual

elastic strain (σ) on measurements of the stacking-fault probability (α), α and σ are calculated from the equation $\delta\Delta 2\theta_{p-q} = K_{p-q}\sigma + H_{p-q}\alpha$ and from measurements of the change in separation between 2 pairs of x-ray reflections. The usual assumption of zero residual strain gives values of α very close to those derived at the assumed extreme of isotropic strain. However, the stress values for both are found unreasonable. It is concluded that the contribution of the residual elastic strain is measurable in lead if the averaging assumption holds true; is quite significant, if the extreme of isotropic stress holds true. It is advised to examine as many x-ray peaks as possible in order to take account of the contribution due to residual strains.

3044

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

THE INFLUENCE OF ELECTROMAGNETIC STIRRING ON THE NUCLEATION OF TIN AND TIN-LEAD ALLOYS, by W. C. Johnston, G. R. Kotler, and W. A. Tiller. [1963] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-J1110) (AF 49(638)1029) AD 421000
Unclassified

Also published in Trans. Metall. Soc. AIME, v. 227: 890-896, Aug. 1963.

Experiments carried out on 100 g samples of molten tin and Sn-Pb alloys showed that the magnitude of the field strength, H, does not effect the supercooling, ΔT_N, at which the initial nucleus of solid forms. However, the number of nuclei forming per cc, n, is found to increase greatly with H for fixed ΔT_N and to increase with ΔT_N for fixed H. The value of n increases greatly with the presence of solute and is found to be independent of the cooling rate of the samples. Further, the most effective time for stirring to enhance n is immediately following the initiation of recalescence. The effect of inducing nucleation with the aid of a mechanical impact both in the presence and absence of stirring has also been studied. All proposed mechanisms for the enhancement of n by physical means seem to be inadequate in accounting for these results. (Contractor's abstract)

3045

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

REDISTRIBUTION OF SOLUTE DURING PHASE TRANSFORMATIONS, by W. A. Tiller and R. F. Sekerka. [1964] [4]p. (AFOSR-65-0163) (AF 49(638)-1029) AD 611468
Unclassified

Also published in Jour. Appl. Phys., v. 35: 2726-2729, Sept. 1964.

The redistribution of solute during phase transformations where solute partitioning occurs at the 2-phase interface is mathematically treated for (1) the special case of equal diffusion rate in both the liquid and solid and (2) diffusion only in the liquid under the additional force of constant electric field. This one-dimensional analysis shows that (1) diffusion in the solid has a small effect on the grown-in solute distribution for $k_0 < 1$ but an appreciable effect for $k_1 < 1$, and (2) the presence of an electric field can significantly alter the grown-in solute distribution. Further, one can deduce from the latter analysis a new experimental method for determining the effective ionic mobility of the solute species in the liquid phase.

3046

Westinghouse Electric Corp. [Westinghouse Research Labs.] Pittsburgh, Pa.

DENDRITES, by W. A. Tiller. [1964] [9]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0771) (AF 49(638)-1029) AD 617045
Unclassified

Also published in Science, v. 146: 871-879, Nov. 13, 1964.

The physics involved in the generation of crystal and dendritic forms is discussed. This generation is considered for both isothermal or unconstrained crystal growth, where crystals grow freely in a large bath of liquid of constant temperature which is below the melting temperature of the crystal; and crystal pulling or constrained crystal growth, where crystals grow from a bath of liquid held at a temperature above the melting temperature of the crystal. Technological applications are also discussed.

3047

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

ICE INTERFACE MORPHOLOGY AND TEXTURE DEVELOPED DURING FREEZING, by J. D. Harrison and W. A. Tiller. [1963] [7]p. incl. illus. diagrs. refs. (AFOSR-65-1996) (AF 49(638)1029) AD 626857
Unclassified

Also published in Jour. Appl. Phys., v. 34: 3349-3355, Nov. 1963.

The freezing of pure water and several aqueous solutions was studied by a direct observation technique. The solid-liquid interface morphology and crystal texture produced during the freezing of water were studied. For the aqueous solutions, 2 families of knife-edged cells formed, one parallel to the basal plane and one parallel to the c axis. Two preferred crystal textures were observed, corresponding to the 2 cell families being aligned with the direction of heat flow. For the freezing of pure water, the same 3 textures were observed; however, the explanation for their occurrence is quite different. Theoretical explanations have been given for all of the texture results and the differences between these results and those found by other investigators. (Contractor's abstract)

3048

[Westinghouse Electric Corp. Westinghouse Research Labs.] Pittsburgh, Pa.

EFFECT OF PRESSURES (UP TO 4KBAR) ON THE POLYMERIZATION OF LIQUID SELENIUM FROM MEASUREMENTS OF VISCOSITY, by D. E. Harrison. [1962] [6]p. incl. diagrs. tables, refs. (AFOSR-65-1999) (AF 49(638)1029) AD 627784   Unclassified

Also published in Jour. Chem. Phys., v. 41: 844-849, Aug. 1, 1964.

The viscosity along the melting curve of selenium is deduced from measurements of the pressure dependence of viscosity taken at various temperatures between 220° - 350°C and at pressures up to 4 kbar. The viscosity is shown to decrease to 1/5 its initial value at 3.0 kbar, then rise with further increase in pressure. Data reveal that the slope of the $\log_{10}$ viscosity vs $1/T^2$ (°K) curve is independent of pressure up to at least 4.5 kbar. Analysis of the effect of pressure on the degree of polymerization in terms of the ring-chain equilibrium theory of Eisenberg and Toholsky indicates that pressure has only a slight effect on the average chain length. Thus, the minimum in viscosity along the melting curve appears to be a balance between the effects of shorter chain length toward decreasing the viscosity and that of diminished free volume toward increasing the viscosity. (Contractor's abstract, modified)

3049

[Westinghouse Electric Corp. Westinghouse Research Labs.] Pittsburgh, Pa.

A METALLOGRAPHIC STUDY OF SOLUTE SEGREGATION DURING CONTROLLED SOLIDIFICATION IN TIN-LEAD ALLOYS, by H. Biloni and G. F. Bolling. [1963] [10]p. incl. illus. diagrs. table, refs. (AFOSR-65-2034) (AF 49(638)1029) AD 627581 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 227: 1351-1360, Dec. 1963.

The microsegregation in tin specimens containing 0.2, 0.5, or 1 wt % Pb was studied. The specimens were grown from the melt in a controlled fashion and exhibited a well-developed cellular substructure. In general, a severe microsegregation can be observed in all the photomicrographs presented. Some observations of special interest are: the distribution of a second phase, the presence of a eutectic in several forms, the evidence for diffusion of solute in the solid, and the enhancement of segregation of a dislocation subboundary network ("striations"). On the basis of the metallographic observations, it is deduced that the segregation observed is representative of the solute segregation produced during crystal growth. Some deductions are also made about the interplay of the 2 substructures, cells and striations, and about the mode of cellular growth. (Contractor's abstract)

3050

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

EVIDENCE FOR THE EXISTENCE OF OVERLAPPING VALENCE AND CONDUCTION BANDS IN SnTe, by D. H. Damon, C. R. Martin, and R. C. Miller. [1963] [3]p. (AFOSR-64-1250) (AF 49(638)1165) AD 442814
                                   Unclassified

Also published in Jour. Appl. Phys., v. 34: 3083-3085, Oct. 1963.

The electrical conductivity, Hall coefficient, and Seebeck coefficient of a sample of SnTe were measured. The Hall coefficient was measured at several positions along the length of the sample and the agreement of these results indicated the sample was homogeneous. The Seebeck coefficient was determined by establishing a temperature gradient in the material, measuring the temperatures of the ends with copper-Constantan thermocouples in contact with the sample and the thermal emf of the Cu-SnTe-Cu couple. This result was corrected to give the absolute Seebeck coefficient of SnTe. Expressions are derived for the change of Seebeck coefficient with magnetic field for 2 different sets of boundary conditions.

3051

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

DEFECT SITES IN VITREOUS SILICA, by P. G. Klemens, J. G. Castle, Jr., and D. W. Feldman. [1964] [3]p. (AFOSR-64-2104) (AF 49(638)1165) AD 451736   Unclassified

Also published in Phys. Chem. Glasses, v. 5: 104-106, Aug. 1964.

Studies of spin-lattice relaxations in crystalline silica have shown the existence of defects with low-frequency mechanical resonances. These defects should lead to unusual scattering of phonons. Such defects were recently found also in vitreous silica. The theory of spin-lattice interaction must now be modified to take account of the short mean free path of transverse phonons in glass. Some implications of these measurements for thermal conduction are discussed.

3052

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

GROWTH AND CHARACTERIZATION OF SINGLE CRYSTALS OF RARE EARTH COMPOUNDS. 1964, 6p. (Quarterly technical rept. no. 10) (AF 49(638)1245) AD 626865   Unclassified

Magnetization measurements were made on the GdNd alloys to ascertain the mode of the spin coupling between a heavy and a light rare earth atom. The magnetic data have substantiated the ferromagnetic spin coupling

assumed in the Dekker theory of electrical resistivity
of the rare earth alloys. Low-temperature resistivities
were determined of several Pd alloys containing solute
atoms of Gd, Rh, and Fe. The electrical data have re-
confirmed the absence of the abnormally large spin-
polarization effect of the localized moments of the Fe
atoms in Pd. Experimental efforts were made to ex-
plore the possible occurrence of resistance minimum
in the Pd-Gd alloys. The effect of local modes at the
impurity centers was examined upon the scattering of
electrons in aluminum between 4.2° and 300°K.

3053

Wisconsin U. [Dept. of Bacteriology] Madison.

THE EFFECT OF POLY U SIZE ON THE INCORPORA-
TION OF PHENYLALANINE IN THE CELL-FREE
YEAST SYSTEM, by L. Marcus, R. K. Bretthauer and
others. [1963] [8]p. (AFOSR-64-2150) (AF 49(638)-
314) AD 452234   Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 50: 782-
789, Oct. 1963.

This study has demonstrated the possibility of measur-
ing messenger RNA function of oligonucleotides short
enough to be completely characterized and thus to estab-
lish the correlation of mRNA structure with peptide
product structure. The results suggest that at least 3
triplets of poly U are required for phenylalanine poly-
merization and that each additional 3 nucleotide units
augments incorporating activity.

3054

Wisconsin U. [Dept. of Bacteriology] Madison.

TIMING OF ENZYME SYNTHESIS DURING SYNCHRO-
NOUS DIVISION IN YEAST, by J. Gorman, P. Taruo
and others. [1964] [7]p. (AFOSR-64-2151) (AF 49-
(638)314) AD 452231   Unclassified

Also published in Biochem. and Biophys. Research
Commun., v. 15: 43-49, 1964.

The method of Williamson and Scopes was employed
to induce the synchronous state with the exception that
the centrifugation for sizing cells after 10 days starva-
tion was omitted, and the cells were finally suspended
in a 0.2% succinate and salts medium at 25°C. The lag
time was 240 min and the generation time 200 min.
The total amounts of RNA and protein doubled within
each generation and the rate of synthesis doubled at the
beginning of each new cell cycle. DNA doubled during
each generation; its synthesis was periodic, initiating
at 0 time of the generation cycle, but complete in 140
min. Nuclear division occurred at a time when buds
appeared and when DNA was not replicated. This may
well reflect a period of karyokinesis analogous to that
of higher organisms where DNA is replicated only during
interphase.

3055

Wisconsin U. Dept. of Bacteriology, Madison.

[MICROPHYSIOLOGICAL STUDIES OF NERVE AND
MUSCLE UNITS] by H. O. Halvorson. Final rept.
Sept. 1, 1963-Aug. 31, 1964, 9p. incl. refs. (AFOSR-
64-2065) (AF AFOSR-63-387) AD 608776
                                        Unclassified

During the course of the past few years a cell-free
system was developed from the hybrid yeast Saccharo-
myces dobzyanskii x S. fragilis. With this system,
it was possible to examine a number of problems dealing
with the mechanism of protein synthesis which are in-
cluded in the final report. In addition, a companion
program was initiated with S. lactis to (1) examine the
similarities in cell-free incorporating systems from
related organisms and (2) to facilitate the isolation of
the transfer enzyme, a step towards a completely de-
fined incorporating system. Cell-free incorporating
systems are generally inefficient and have a short half-
life. One of the major defects is usually attributed to
nuclease action. To better understand and control
nuclease action in cell extracts, a further characteriza-
tion of these enzymes was undertaken.

3056

Wisconsin U. Dept. of Chemistry, Madison.

NEW AROMATIC ANIONS. VI. COMPLEXES OF
CROCONATE ION WITH SOME DIVALENT AND TRI-
VALENT METALS, by R. West and J. Y. Niu. [1963]
[3]p. incl. diagrs. tables. (AFOSR-64-0223) (AF 49-
(638)285) AD 432512   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85:
2586-2588, Sept. 5, 1963.

Complexes of croconate ion with the divalent metal ions
Cu, Fe, Zn, Ni, Mn, Co, and Ca and trivalent Al, Fe
and Cr have been prepared and characterized by means
of analysis, infrared spectroscopy, powder x-ray dif-
fraction, and magnetic studies. All of the divalent
metal complexes have the general formula
$MC_5O_5 \cdot 3H_2O$. The divalent transition metal compounds
are all high-spin complexes, and all have the same
polymeric structure, determined from a single-crystal
x-ray analysis of the copper(II) compound. The trivalent
metal complexes have more complicated formulas con-
taining hydroxyl groups, and those of Fe(III) and Cr(III)
show paramagnetism lower than that expected for high-
spin complexes.

3057

Wisconsin U. Dept. of Chemistry, Madison.

IONIC REACTIONS IN BICYCLIC SYSTEMS. IV.
STEREOCHEMISTRY OF THE ACETOLYSIS OF (+)-
ENDOBICYCLO[2.2.2]OCT-5-EN-2-YL p-TOLUENE-
SULFONATE, by H. L. Goering and D. L. Towns.
[1963] [4]p. incl. table, refs. (AFOSR-4546) (AF 49-
(638)721) AD 439991   Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2295-2298, Aug. 5, 1963.

Acetolysis of (+)-endo-bicyclo[2.2.2]oct-5-3n-2-yl p-toluenesulfonate results in equal first-order rates of loss of optical activity and solvolysis. The major component in the product is exo(axial)-btcyclo-[3.2.1] oct-3-en-2-yl acetate and this appears to be completely racemic. These results, together with the observation that acetolysis is anchimerically accelerated, are consistent with the view that ionization results in the direct formation of the symmetrical bicyclo[3.2.1]oct-3-en-2-yl carbonium ion which is stereoselectively converted to the exo-acetate I. (Contractor's abstract)

3058

Wisconsin U. Dept. of Chemistry, Madison.

HYDROGEN-HALOGEN EXCHANGE BETWEEN SILANES AND TRIPHENYLMETHYL HALIDES, by J. Y. Corey and R. West. [1963] [4]p. incl. diagrs. tables, refs. (AFOSR-64-0161) (AF AFOSR-62-244) AD 432556
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2430-2433, Aug. 20, 1963.

Triphenylmethyl halides will halogenate silanes at 25°C in polar solvents. The reaction is rapid in partially chlorinated hydrocarbons, nitromethane, and nitrobenzene, show in acetonitrile and benzene, and does not take place in ethers, hydrocarbons, or fully chlorinated hydrocarbons at room temperature. Benzhydryl and t-butyl halides are inactive but react to give hydrogen-halogen exchange in the presence of boron tribromide. A preliminary study of the kinetics of the reaction between triphenylchloromethane and triphenylsilane in benzene indicates probable first-order dependence of the rate on each reactant. A mechanism is suggested involving 4-center attack of a carbonium ion-halide ion pair on the Si-H bond. Preparative applications of the reaction are also discussed. (Contractor's abstract)

3059

Wisconsin U. Dept. of Chemistry, Madison.

NEW AROMATIC ANIONS. VII. COMPLEXES OF SQUARATE ION WITH SOME DIVALENT AND TRIVALENT METALS, by R. West and H. Y. Niu. [1963] [2]p. incl. tables. (AFOSR-64-0216) (AF AFOSR-62-244) AD 432505
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2589-2590, Sept. 5, 1963.

Complexes of squarate ion (diketocyclobutenediol dianion) with divalent Cu, Fe, Zn, Ni, Mn, Co, Ca, and Mg, and with trivalent Al, Fe, and Cr, have been prepared and characterized. All of the divalent metal complexes are dihydrates and all except the Cu and Ca compounds have the same structure. The 3 trivalent metal complexes are isostructural and have the general formula $MC_4O_4(OH)(H_2O)_2$. The magnetic moments

of the divalent metal compounds indicate that they are high-sptn complexes, but the Fe(III) and Cr(III) complexes show somewhat reduced paramagnetism. A polymeric structure is suggested for divalent metal complexes. (Contractor's abstract)

3060

Wisconsin U. [Dept. of Chemistry] Madison.

PI-BONDED ORGANOSILICON COMPOUNDS, by R. West. Final rept. Feb. 1, 1962-Jan. 1, 1964. Apr. 20, 1964, 11p. (AFOSR-64-1090) (AF AFOSR-62-244) AD 601691
Unclassified

Summaries are given of researches in the following areas: silcontum tons; organometallic azides; organosilicon free radicals, and electronic spectra of organometallic compounds.

3061

Wisconsin U. Dept. of Chemistry, Madison.

SYNTHESIS OF A SILAZAROPHENANTHRENE, by J. M. Gaidis and R. West. [1964] [2]p. incl. diagr. (AFOSR-65-0532) (AF AFOSR-62-244) AD 613923
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5699-5700, Dec. 1964.

The compound 10,10-dimethyl-9,10-azasiladihydrophenanthrene was synthesized by photolysis of an organosilyl azide after unsuccessful attempts by more direct methods, e.g., those used for heteroaromatic boron and phosphorus compounds. This reaction is an example of insertion of monovalent nitrogen from an organometallic azide into a C-H bond.

3062

Wisconsin U. Dept. of Chemistry, Madison.

A NOVEL REARRANGEMENT OF 1,2-BIS(TRIMETHYLSILYL)-HYDRAZINE, by R. E. Bailey and R. West. [1964] [1]p. incl. refs. (AFOSR-65-0534) (AF AFOSR-62-244) AD 614290
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5369, Dec. 1964.

When 1,2-bis(trimethylsilyl)hydrazine is treated with 2 equtv. of n-butyllithium in tetrahydrofuran and then with 2 equiv. of methyl iodide, the reaction mixture is found to contain both the expected product 1,2-bis(trimethylsilyl)1,2-dimethylhydrazine, and the rearranged product, 1,1-bts(trimethylsilyl-2,2-dimethylhydrazine. The rearrangement involves the migration of silicon from 1 nitrogen to another. Presently, it ts known whether the rearrangement occurs during or after treatment with n-butyllithium, or even conceivably during the reaction with methyl iodide.

3063

Wisconsin U. Dept. of Chemistry, Madison.

TRIMETHYLAZIDO COMPOUNDS OF GROUP IVA
ELEMENTS, by J. S. Thayer and R. West. [1964]
[5]p. incl. diagrs. tables, refs. (AFOSR-64-1541)
(AF AFOSR-64-623) AD 446134   Unclassified

Also published in Inorg. Chem., v. 3: 889-893,
June 1964.

Azidotrimethyl derivatives of silicon, germanium, tin,
and lead were prepared, and a comparative study of
their physical properties was carried out. Infrared
and electronic spectra were interpreted in terms of
dative π-bonding in the silicon and germanium com-
pounds. In the organosilicon conversion series, the
azide group occupies the same position as isocyanate.
(Contractor's abstract)

3064

Wisconsin U. [Dept. of Mathematics] Madison.

A THEOREM OF MAXIMUM MODULUS, by A. Beck.
[1964] [5]p. (AFOSR-64-2362) (AF 49(638)868)
AD 452232   Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 345-
349, June 1964.

The theorem states that if D is a domain in the plane
of complex numbers, then every analytic function
achieves its maximum modulus only at the boundary.

3065

Wisconsin U. [Dept. of Mathematics] Madison.

ON RINGS ON RINGS, by A. Beck. [1964] [4]p.
(AFOSR-64-2363) (AF 49(638)868) AD 452233
                        Unclassified

Also published in Proc. Amer. Math. Soc., v. 15:
350-353, June 1964.

This paper presents a solution to a popular problem in
the subject of rings of analytic functions. It was
previously shown that two domains D_1 and D_2 in the
complex plane were conformally equivalent (to within
a certain equivalence relation) if the rings $B(D_1)$ and
$B(D_2)$ of all bounded analtyic functions defined on them
were algebraically isomorphic. In the case of annuli,
two are conformally equivalent if the ratio of the radii
of one equals the same ratio for the other. It follows
that this ratio must be contained somewhere in the
algebraic structure of the ring.

3066

Wisconsin U. [Dept. of Mathematics] Madison.

NONABSORPTION PROBABILITY FOR A GAUSSIAN

PROCESS IN THE KARHUNEN REPRESENTATION, by
J. Chover. [1964] [17]p. incl. refs. (AFOSR-64-2486)
(AF 49(638)868) AD 453795   Unclassified

Also published in Duke Math. Jour., v. 31: 427-443,
Sept. 1964.

Sample functions of a given Gaussian process X(t) which
have a finite (N-term) Karhunen expansion are con-
sidered. It is easy to see how nonabsorption probability
depends on three distinct sets of input data: (1) the eigen-
values of $r(s, t)$ (considered as integral kernel), (2) the
corresponding eigenvectors, and (3) the boundaries.
The nonabsorption probabilities are interpreted in terms
of a simple diffusion in N-space. An estimate for the
error involved in truncating a Karhunen expansion after
the N-th term is given, and a crude lower bound for the
nonabsorption probability of a truncated series, for the
one-sided case is discussed.

3067

Wisconsin U. [Dept. of Minerals and Metals
Engineering] Madison.

STRESS-CORROSION CRACKING OF COPPER-GOLD
SINGLE CRYSTALS, by J. Hardwick and R. A. Dodd.
1963, 11p. (AFOSR-5336) (AF AFOSR-61-68)
AD 421517   Unclassified

The stress-corrosion susceptibility range of the copper-
gold system was measured, using single crystals loaded
to give 5% glide strain in 2% ferric chloride. Alloys
containing less than about 10 at.-% gold fail by the pro-
gressive reduction of cross section due to general cor-
rosive attack. Alloys containing between 10 and 29 at.-%
gold fail by stress corrosion, with the stress-corrosion
susceptibility steadily increasing up to 29 at.-% gold.
Those alloys containing in excess of this gold content
are not susceptible to stress-corrosion.

3068

Wisconsin U. Dept. of Minerals and Metals
Engineering, Madison.

MECHANISM OF STRESS-CORROSION CRACKING IN
FACE-CENTERED-CUBIC METALS, by R. A. Dodd.
Final technical rept. [1963] [5]p. (AFOSR-J1128)
(AF AFOSR-61-68) AD 421724   Unclassified

The purpose of the research was to attempt an evaluation
of those structural parameters which are possibly sig-
nificant in giving rise to the phenomenon of stress-cor-
rosion cracking in face-centered-cubic metals. Param-
aters investigated included dislocation configurations,
stacking faults and energies, and long and short-range
order. Studies included copper-gold and silver-gold
single crystals.

3069

Wisconsin U. [Dept. of Minerals and Metals
Engineering] Madison.

STRESS-CORROSION CRACKING OF SHORT-RANGE-
ORDERED COPPER-GOLD SINGLE CRYSTALS, by J.
M. Hardwick and R. A. Dodd. [1964] [2]p. (AFOSR-
64-2106; (AF AFOSR-61-68) AD 451701
                                        Unclassified

Also published in Jour. Inst. Metals, v. 92: 339-340,
1963-1964.

Stress-corrosion cracking of solid-solution alloys
has been the subject of many investigations, but the
mechanism of cracking cannot yet be said to be com-
pletely understood. The complicating effects of grain
boundaries can be avoided by the use of single crystals,
and the following results for copper-gold single crystals
show that the stress-corrosion lifetime has a simple
dependence on composition which can be satisfactorily
explained in terms of a theory for transgranular crack-
ing.

3070

Wisconsin U. [Dept. of Sociology] Madison.

A VERY SHORT TEST OF PERSONALITY: THE BE-
HAVIORAL SELF-RATING (BSR) FORM, by E. F.
Borgatta. [1964] [10]p. (AFOSR-64-0833) (AF AFOSR-
62-16) AD 438390   Unclassified

Also published in Psychol. Repts., v. 14: 275-284,
1964.

Reliability and validity data are presented for a factor
analytically based short test of personality. The form
is essentially a behavioral characteristics, self-rating
check list. Use is recommended for screening purposes
only where time is at a premium. The names of the 5
scores of the test are: assertiveness, likeability, in-
telligence, emotionality, and responsibility.

3071

Wisconsin U. [Dept. of Sociology] Madison.

A NOTE ON THE STABILITY OF PEER JUDGMENTS
IN INDEPENDENT SITUATIONS, by E. F. Borgatta
and B. C. Sperling. [1963] [3]p. incl. table. (AFOSR-
64-1484) (AF AFOSR-62-16) AD 445171
                                        Unclassified

Also published in Jour. Psychol. Studies, v. 14: 45-
47, 1963.

Utilizing the multitrait-multimethod approach, a rep-
lication study is reported indicating the stability of
peer assessments in independent situations. Composite
peer-ranking scores of assertiveness, sociability,
and emotionally based on fraternity and sorority group-
ings are compared with parallel scores in ad hoc mixed-
sex discussion groups. (Contractor's abstract)

3072

Wisconsin U. [Dept. of Sociology] Madison.

A NEW SYSTEMATIC INTERACTION OBSERVATION
SYSTEM: BEHAVIOR SCORES SYSTEM (BSs SYSTEM),
by E. F. Borgatta. [1963] [21]p. incl. diagr. tables.
(AFOSR-64-1485) (AF AFOSR-62-16) AD 445172
                                        Unclassified

Also published in Jour. Psychol. Studies, v. 14: 24-
44, 1963.

A new interaction scoring system is presented, along
with a brief description of the underlying rationale. A
sample study is reported to illustrate the relationship
of the observation categories to observed interaction.
The observation categories are correlated to peer
assessments, and profile data are presented with dis-
tribution characteristics. A sample protocol to illus-
trate scoring is presented in an appendix. (Contractor's
abstract)

3073

Wisconsin U. [Dept. of Sociology] Madison.

A NOTE ON THE CONSISTENCY OF SUBJECT BE-
HAVIOR IN INTERACTION PROCESS ANALYSIS, by
E. F. Borgatta. [1964] [8]p. incl. table. (AFOSR-64-
1956) (AF AFOSR-62-16) AD 440320   Unclassified

Also published in Sociometry, v. 27: 222-229, June
1964.

Consistency in interaction behavior is examined for 3
observation situations: 5-person and 3-person discus-
sion groups and 3-person, structured role-playing
groups. Substantial consistency in subject behavior is
found in the first two situations, but there is little pre-
diction to role-playing. Attention is focused on the
question of which aspects of social interaction reflect
personality most and which are most subject to situa-
tional variation. (Contractor's abstract)

3074

Wisconsin U. [Dept. of Zoology] Madison.

FUNCTION OF A LIGHT RESPONSE RHYTHM IN
HAMSTERS, by P. J. DeCoursey. [1964] [8]p.
(AFOSR-64-1692) (AF 49(638)691) AD 447697
                                        Unclassified

Also published in Jour. Cellular and Compar. Physiol.,
v. 63: 189-196, Apr. 1964.

An assay both my means of short, single light exposures
and by light synchronization experiments indicated a
light response rhythm in hamsters. The magnitude and
direction of the phase shifts were related to the time in
the daily activity cycle at which light occurred. Such
a response rhythm appeared highly adaptive for main-
taining a nocturnal pattern in a light-dark cycle for all
members of the species.

3075

Wisconsin U. [Dept. of Zoology] Madison.

ADAPTIVE ASPECTS OF ACTIVITY RHYTHMS IN
BATS, by G. DeCoursey and P. J. DeCoursey. [1964]
[14]p. (AFOSR-64-1693) (AF 49(638)691) AD 447698
                                    Unclassified

Also published in Biol. Bull., v. 126: 14-27, Feb.
1964.

Bats living under laboratory or field conditions mani-
fested precise nocturnal activity rhythms. Light-sam-
pling at the light-to-dark transition was apparently the
chief means of synchronizing an endogenous, non-24-hr
activity rhythm to the daily light cycle. Two horseshoe
bats, free-living in separate, small recording rooms,
readily adjusted the time of activity to correspond to an
L:D schedule. Three horseshoe bats, roosting in a
darkened tunnel with no direct view of the 12L:12D sched-
ule of the outside room, anticipated the light-dark change
by flying out regularly during the hour before the lights
were turned out, then were active for about 8 hr.

3076

Yale U. [Dept. of Astronomy] New Haven, Conn.

A GROUP OF EARTH-TO-MOON TRAJECTORIES
WITH CONSECUTIVE COLLISIONS, by V. Szebehely,
D. A. Pierce, and E. M. Standish, Jr. [1964] [17]p.
(AFOSR-64-2491) (AF AFOSR-64-397) AD 454017
Unclassified

Also published in Prog. Astronaut. and Aeronaut.,
v. 14: 35-51, 1964.

A set of trajectories connecting the earth and the moon
is described. All members of this group of orbits go
through, in extension, the centers of the earth and the
moon, and are therefore termed orbits with consecutive
collisions. The model of the planar restricted problem
of three bodies is used, and the equations of motion are
regularized in order to obtain solutions through the
singularities. The principles of regularization are
discussed in some detail. The members of the group
of orbits presented in this paper are of considerable
interest because they are simple and because several
of them are closely related to trajectories proposed for
Apollo-type missions.

3077

Yale U. Dept. of Mathematics, New Haven, Conn.

REAL BANACH ALGEBRAS, by L. Ingelstam. [1964]
[32]p. (AFOSR-65-2611) (AF AFOSR-63-407)
AD 629083   Unclassified

Also published in Arkiv Mat., v. 5: 239-270, 1964.

This article contributes to the theory of real Banach
algebras in three central areas: (1) the structure of
the (quasi-) regular group, (2) abstract characterization
of real function algebras, and (3) the relation between
real B- and C-algebras.

3078

Yale U. [Dept. of Mathematics] New Haven, Conn.

ON THE MAXIMALITY THEOREM OF WERMER, by
T. P. Srinivasan and J.-K. Wang. [1963] [2]p.
(AFOSR-66-0015) (AF AFOSR-63-407) AD 631114
Unclassified

Also published in Proc. Amer. Math. Soc., v. 14:
997-998, Dec. 1963.

The maximality theorem proven is as follows: let C
denote the sup-norm algebra of all continuous functions
on the unit circle, and let A denote the subalgebra of
those functions which have analytic extensions to the
interior. Then A is a maximal closed subalgebra of C.

3079

Yale U. [Dept. of Physics] New Haven, Conn.

ENERGY OF GRAIN BOUNDARIES IN NaCl TRI-
CRYSTALS, by R. L. Moment and R. B. Gordon.
[1963] [23]p. incl. illus. diagrs. refs. (AFOSR-J1214)
(AF 49(638)786) AD 425098   Unclassified

Relative grain boundary energy measurements have
been made for [100] tilt boundaries in NaCl crystals.
Significant torque term effects - dependence of the
boundary energy on boundary orientation - occur in this
material. The general dependence on boundary energy
on misorientation is similar to that in metals. (Con-
tractor's abstract)

3080

Yale U. [Dept. of Physics] New Haven, Conn.

IONIC CONDUCTIVITY IN LiF GRAIN BOUNDARIES,
by R. L. Moment and R. B. Gordon. [1964] 18p. incl.
diagrs. table, refs. (AFOSR-64-2350) (AF 49(638)786)
AD 451939   Unclassified

Also published in Jour. Appl. Phys., v. 35: 2489-2492,
Aug. 1964.

Tilt boundaries in LiF bicrystals have been doped with
Na^+ ions and the resulting enhanced ionic conductivity
measured. The activation energy associated with this
conductivity is found to be 0.32 ev and is a constant,
independent of the grain misorientation. This activation
energy is the same as for the enhanced conductivity
observed in Na^+ ion doped edge dislocations in LiF.
The results are interpreted in terms of a disordered
boundary structure containing a high vacancy concentra-
tion. (Contractor's abstract)

3081

Yale U. [Dept. of Physics] New Haven, Conn.

ENERGY OF GRAIN BOUNDARIES IN HALITE, by R.
L. Moment and R. B. Gordon. [1964] [4]p. incl. illus.
diagrs. (AFOSR-65-0769) (AF 49(638)786)
AD 616049   Unclassified

Also published in Jour. Amer. Ceram. Soc., v. 47:
570-573, Nov. 1964.

Relative grain boundary energy measurements were
made by the tricrystal method for [100] tilt boundaries
in NaCl. The dependence of boundary energy on grain
misorientation was similar to that in metals; however,
the presence of significant torque term effects, i.e.,
dependence of the boundary energy on boundary orienta-
tion is indicated. A method of measuring the relative
magnitudes of the torque terms by applying a driving
force to boundaries in bicrystals is described. (Con-
tractor's abstract)

3082

Yale U. [Dept. of Physics] New Haven, Conn.

THE SEMICLASSICAL TREATMENT OF SOME QUAN-
TUM PROBLEMS, by G. Breit. [1963] [22]p. (AFOSR-
J279) (AF AFOSR-62-42) AD 400879   Unclassified

Also published in Zeitschr. Phys., v. 171: 149-170,
1963.

The semiclassical treatment of quantum mechanical
problems is discussed making use of a generalization
of the Hamilton-Jacobi partial differential equation to
cases in which only some of the variable of the problem
are treated classically. The quantum equations are
put into a form in which the effects not covered by the
semiclassical approximation are concentrated into one
set of terms. This enables one to calculate corrections
to the semiclassical theory and to demonstrate that
compensations of the decrease of scattering in the co-
herent (elastic) channel by the increase caused by the
presence of incoherent (inelastic) channels which is
exact in the semiclassical approximation holds in a
certain approximation quantum mechanically. By means
of these relationships it is shown that some and pre-
sumably the main contributions to the dynamical effects
of molecular electrons interacting with protons in ex-
periments on proton-proton and proton-neutron scatter-
ing are negligibly small.

3083

Yale U. [Dept. of Physics] New Haven, Conn.

HIGH-ENERGY DIFFRACTION SCATTERING, by L.
Durand, III and K. R. Greider. [1963] [9]p. (AFOSR-
64-0507) (AF AFOSR-63-394) AD 436167
                                    Unclassified

Also published in Phys. Rev., v. 132: 1217-1225,
Nov. 1, 1963.

The experimental data on elastic proton-proton scatter-
ing have been analyzed in a phenomenological manner
using the impact-parameter representation for the
scattering amplitude in the form given by Blankenbecler
and Goldberger. The detailed shape and energy de-
pendence of the elastic differential cross section, the
small ratio of the elastic-scattering cross section to
the total cross section, and the constant total cross
section can all be explained with remarkable ease using
a smooth weight function with reasonable properties.

3084

Yale U. [Dept. of Physics] New Haven, Conn.

NEUTRON TRANSFER IN $N^{14}(N^{14}, N^{13})N^{15}$ AT LOW
ENERGIES, by G. Breit, K. W. Chun, and H. G.
Wahsweiler. [1964] [6]p. incl. diagrs. refs. (AFOSR-
64-0650) (AF AFOSR-63-394) AD 435939
                                    Unclassified

Also published in Phys. Rev., v. 133: B403-B408,
Jan. 27, 1964.

Formulas concerned with approximate quantum mechani-
cal corrections to the semiclassical (SC) treatment of
the neutron transfer reaction previously contained or
implied in the literature are extended. At 18 and at
12.6 mev reasonable agreement with experimental
angular distributions is found close to 90° in the cm
system. At smaller angles the experimental values of
the cross section are below those calculated at 18 mev,
in agreement with the influence of absorption on the re-
coils suggested for this case; at 12.3 mev the experi-
mental values are somewhat smaller than the theoretical
as would be the case in the presence of virtual Coulomb
excitation (VCE). Total transfer cross sections show
a systematic increase over expectation by a factor of
about 2.9 between 9.0 and 12.8 mev as though some VCE
were present. The calculated ratio of the 90° cross
section at 18 mev to that at 12.6 mev is about 10 times
that observed. Possible explanations of this discrepancy
are discussed. (Contractor's abstract, modified)

3085

Yale U. Dept. of Physics, New Haven, Conn

NUCLEUS-NUCLEUS REARRANGEMENT SCATTERING.
I, by K. R. Greider. [1964] [12]p. incl. diagr. refs.
(AFOSR-64-1768) (AF AFOSR-63-394) AD 449268
                                    Unclassified

Also published in Phys. Rev., v. 133: B1483-B1494,
Mar. 23, 1964.

Direct-interaction techniques are applied to nucleus-
nucleus rearrangement processes in which a nucleon
is transferred from one nucleus to the other during the
scattering. A formal expression is derived for the
transition amplitude assuming a reaction mechanism
different from that usually employed in direct-interac-
tion rearrangement processes. The mechanism in the
usual theories is due to the potential between the trans-
ferred particle and one of the nuclear core systems; in
the present treatment the interaction between the two
nuclear cores is considered responsible in first order
for the rearrangement scattering.

3086

Yale U. Dept. of Physics, New Haven, Conn.

NUCLEUS-NUCLEUS LONG-RANGE INTERACTION
POTENTIAL IN ELASTIC SCATTERING, by J. S.
McIntosh, S. C. Park, and G. H. Rawitscher. [1964]
[12]p. incl. diagrs. tables, refs. (AFOSR-64-2061)
(AF AFOSR-63-394) AD 452447   Unclassified

Also published in Phys. Rev., v. 134: B1010-B1021,
June 8, 1964.

Differential cross sections are calculated for the elastic
scattering of heavy nuclei by heavy nuclei and the re-
sults are compared with experiment. The long-range
part of the nucleus-nucleus interaction is assumed to be
representable by a two-body potential, and the attempt
is made to calculate the latter in terms of the experi-
mentally determined nucleon-nucleus optical-model po-
tential extrapolated to negative energies at the surface

of each nucleus. The short-range part of the nucleus-nucleus interaction is represented schematically by a complex potential or an ingoing wave boundary condition, the justification for which as a representation of the optical-model potential is given. Reasonable agreement with experiment is obtained for the experimental data considered, if the average-reduced-width parameter equal to about one-fifth the corresponding single-particle value is employed. (Contractor's abstract)

3087

Yale U. [Dept. of Physics] New Haven, Conn.

ELECTRON AND MUON SCATTERING FROM NUCLEAR CHARGE DISTRIBUTIONS AT INCIDENT MOMENTA BETWEEN 50 AND 183 MEV/C, by C. R. Fischer and G. H. Rawitscher. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0141) (AF AFOSR-63-394)
AD 455827   Unclassified

Also published in Phys. Rev., v. 135: B377-B383, July 27, 1964.

The comparison of theoretical elastic-scattering cross sections of positrons and electrons from Woods-Saxon (WS) and wine-bottle (WB) charge distributions of the nucleus of Au, carried out at 183 mev, is extended to lower energies and repeated for muons of comparable incident momenta. It is found that, for momentum transfers of less than 1.5 F^{-1}, the % change of the cross section corresponding to a change from the WS to the WB charge distribution is largest, of the order of 30% for incident momenta of ~ 100 mev/c, particularly for positrons. At an electron energy of 50 mev the cross section depends mainly on the mean-square radius of the nucleus, and an accuracy better than 5% is needed in order to determine additional nuclear charge distribution parameters. The mean-square radii of the WS and WB charge distributions differ by 6.5% while the corresponding electron cross sections at 50 mev differ by a maximum of 10%. A comparison with experimental elastic positron and electron scattering cross sections for Pb is carried out. (Contractor's abstract, modified)

3088

Yale U. [Dept. of Physics] New Haven, Conn.

DETERMINATION OF THE TOTAL ANGULAR MOMENTUM OF RESIDUAL NUCLEAR STATES FROM DEUTERON STRIPPING ANGULAR DISTRIBUTIONS, by K. R. Greider. [1964] [6]p. incl. diagrs. refs. (AFOSR-65-0143) (AF AFOSR-63-394) AD 455941
                                    Unclassified

Also published in Phys. Rev., v. 136: B420-B425, Oct. 26, 1964.

A model based on diffraction techniques yields general formulas for large-angle differential cross sections in deuteron stripping, and other rearrangement, reactions in which the entrance- and exit-channel particles are strongly absorbed. It is found that for a spin-zero target, the character of the large-angle distributions

depends critically on the angular-momentum transfer L, or parity of the residual state, in an unusual way. For L even, cross sections exhibit oscillations that have twice the period of the usual forward-angle stripping oscillations, while for L odd, there is almost no oscillatory structure. Furthermore, the even-L oscillations for L = 4n are out of phase with those of L = 4n + 2, $n = 0, 1, \cdots$. A unique determination of the total spin $J = L \pm \frac{1}{2}$ of the residual nuclear state in deuteron stripping is possible when entrance- and exit-channel spin-orbit scattering, proportional to $\sigma \cdot 1$, is introduced into the diffraction model. The spin-orbit amplitude is characterized by distributions of opposite parity from the spin-independent amplitude. For the case of L odd, the spin-independent amplitude is a relatively smooth function of angle, characteristic of odd-parity distributions, while the spin-dependent amplitude exhibits the even-parity (L ± 1) large-angle diffraction oscillations. (Contractor's abstract, modified)

3089

Yale U. [Dept. of Physics] New Haven, Conn.

SCATTERING OF PIONS BY LIGHT NUCLEI, by M. M. Sternheim. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-0508) (AF AFOSR-63-394) AD 614087
                                    Unclassified

Also published in Phys. Rev., v. 135: B912-B920, Aug. 24, 1964.

The scattering of pions by light nuclei is calculated using an approximate, high-energy, small-angle multiple-scattering expansion which neglects off-the-energy shell scattering. The approximations needed to obtain this expansion from an exact multiple-scattering theory are examined. It is found that the unknown contribution of the off-the-energy shell scattering makes any calculation of pion-nucleus scattering unreliable for large angles. Using pion-nucleon phase shifts and electron-scattering data, results are obtained for the scattering of pions of about 80 mev by lithium, carbon, and oxygen. (Contractor's abstract)

3090

Yale U. Sloane Physics Lab., New Haven, Conn.

RELAXATION RATES OF THE Ar$^+$ LASER LEVELS, by W. R. Bennett, Jr., P. J. Kindlmann and others. [1964] [3]p. incl. illus. table, refs. (AFOSR-65-0112) (AF AFOSR-64-626) AD 611996   Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 158-160, Oct. 15, 1964.

In order to investigate the relative importance of factors that contribute to the excitation of states such as the $3p^4(^3P)4p$ state of Ar$^+$ from the neutral ground state, direct measurements were made of the radiative and collision-induced relaxation rates of all the upper Ar$^+$ laser states. The results show that: (1) the radiative lifetimes of these states range from ~ 7 to 10 nsec; (2) the destructive collision cross-sections are too

small to affect these lifetimes at the optimum pressure for laser oscillation; and (3) direct Ar^+ excitation cross-sections are comparable with those for neutral Ar.

3091

Yale U. Sloane Physics Lab., New Haven, Conn.

REVIEW OF RECENT PROGRESS WITH GASEOUS ION LASERS (Abstract), by W. R. Bennett, Jr. [1964] [1]p. (AFOSR-65-0113) (AF AFOSR-64-626)
Unclassified

Also published in Jour. Opt. Soc. Amer., v. 54: 1389, 1964.

Use of high-energy electron impact and high-current discharges has permitted obtaining laser oscillation between ionic states in gas systems on wavelengths ranging from UV to the near IR. In particular, the pulsed and cw power capabilities of the noble-gas ion lasers have exceeded conventional neutral-gas systems by a considerable margin. The visible systems have also been characterized by extremely high gain and strong superradiance effects. Various correlation studies indicate that plasma interactions, e.g., the pinch effect, are involved in the energy-transfer process in these high-current systems. A review of these excitation processes is given and summaries of measured lifetimes, gain, and power coefficients are presented.

3092

Yale U. [Sloane Physics Lab.] New Haven, Conn.

RADIAL PROFILE AND SATURATION CHARACTER-ISTICS OF THE 1.1523-μ He-Ne LASER TRANSITION (Abstract), by W. R. Bennett, Jr. and J. W. Knutson. [1964] [1]p. (AFOSR-65-0114) (AF AFOSR-64-626)
Unclassified

Presented at Spring meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

Also published in Bull. Amer. Phys. Soc., Series II, v. 9: 500, 1964.

Profiles of single-pass gain at optimal pressures were measured with a 2 mm probe and 15 mm discharge tube. Constant-temperature inversion densities satisfy $I(r, \xi) \approx I_{max} J_0 (2.4r/R) \xi [2 - f(r) \xi]$, where $f(r) \approx 1 - 0.2$ $(r/R)^2$ R the tube radius and ξ increases with upper-level excitation. Increasing gas temperature raises I_{max} by increasing lower-state relaxation. Higher-pressure neon discharges exhibit lower-state densities varying as $\approx J_0^2$ as compatible with electron excitation from neon metastables. Observed $I(r, \xi)$ are not compatible with this saturation mechanism near optimum, however. Resonance-trapping by metastable levels may explain the 1/R dependence of I_{max}. An interpretational check depends on numerical solutions to the resonance-trapping problem. The form of $I(r, \xi)$ explains selective excitation of odd-symmetric cavity modes at high discharge intensities.

3093

Yale U. [Sloane Physics Lab.] New Haven, Conn.

ADDITIONAL CASCADE LASER TRANSITIONS IN He-Ne MIXTURES (Abstract), by W. R. Bennett, Jr., A. T. Pawlikowski, and J. W. Knutson. [1964] [1]p. (AFOSR-65-0115) (AF AFOSR-64-626) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

Also published in Bull. Amer. Phys. Soc., Series II, v. 9: 500, 1964.

Continuous oscillation was obtained on the $3p_4 \rightarrow 2s_4$ and $3p_2 \rightarrow 2s_5$ transitions of neon at 2.0350 and 1.9577 μ. Population of the $3p_4$ level is obtained directly from laser oscillation on the strong $3s_2 \rightarrow 3p_4$ transition at 3.3913 μ. The $3p_2$ presumably arises in collision transfer from the $3p_4$ ($\Delta E \approx 0.9$ cm^{-1}). Stimulated emission was not employed as a lower-state relaxation mechanism. A 3 m confocal laser was used with quartz Brewster-angle windows, 5 mm id and dielectric mirror coatings peaked at 1.95 μ. Both transitions have comparatively high rf levels for oscillation threshold and are enhanced at the leading edge of the excitation pulse when the rf is modulated. Although the 2.0350 μ transition has a lower threshold than the 1.9577 μ line, comparable output-power levels were obtained from both well above threshold. At optimum pressures, i.e., $P_{He} \approx 1$ mm Hg and $P_{Ne} \approx 0.1$ mm Hg, saturation could not be obtained with the rf supply available.

3094

Yale U. Sloane Physics Lab., New Haven, Conn.

SIMULTANEOUS LASER OSCILLATION ON THE NEON DOUBLET AT 1.1523 u, by W. R. Bennett, Jr. and J. W. Knutson, Jr. [1964] [1]p. incl. diagr. refs. (AFOSR-65-0416) (AF AFOSR-64-626) AD 612327
Unclassified

Also published in Proc. IEEE, v. 52, July 1964.

The inversion possibilities on the $2s_4 \rightarrow 2p_7$ neon transition were examined. Oscillation was obtained on this transition under two different conditions: first, using electron impact in pure neon; second, in helium-neon mixtures, through use of stimulated emission pumping and multiply-resonant mirror coatings. Only the electron impact results appear of practical value for precision measurements. Beam powers ≈ 1 mw were obtained simultaneously from these two transitions in discharges containing pure neon and the gain coefficients of these two lines appear sufficient to permit simultaneous single mode operation in smaller cavities. The present gain measurements are compatible with the previous data at 1.1523 μ and the assumption of a reciprocal diameter dependence of the inversion density at optimum excitation.

3095

Yale U. [Sterling Chemistry Lab.] New Haven, Conn.

MOLECULAR FRAGMENTS IN SHOCK WAVES, by R.
S. Berry. Final rept. Nov. 1, 1960-Oct. 31, 1962, 5p.
(AFOSR-J1376) (AF AFOSR-61-35) AD 426567
Unclassified

The possibility of observing absorption spectra of free,
gaseous negative ions like chloride or oromide was
investigated. The technique proposed was the vaporiza-
tion and dissociation of alkali halides by a shock wave,
followed by short duration absorption spectroscopy.
The photodetachment spectra, continuous absorption
spectra were obtained for chlorine, bromine, and iodine.
From these spectra, precise values of the halogen
electron affinities were obtained. The fluoride spectrum
was also obtained. The method of flash photolysis with
flash spectroscopy was applied to three known precur-
sors of benzene: benzenediazonium-2-carboxylate, o-
iodophenyl mercuric iodide and di-o-iodophenyl mercury.
Chemical products were strongly indicative of the pres-
ence of gaseous benzene, and a transient broad continu-
ous absorption spectra was obtained which has been
assigned to benzyme.

3096

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THERMODYNAMICS AND ELEMENTARY PROCESSES
OF GASEOUS IONS, by R. S. Berry. [1963] [63]p.
incl. diagrs. table, refs. (AFOSR-64-0252) (AF
AFOSR-63-183) AD 431491   Unclassified

Presented at AIAA Conf. on Ions in Flames and Rocket
Exhausts, Palm Springs, Calif., Oct. 10-22, 1962.

Also published in Prog. Astronaut. and Aeronaut.,
v. 12: 3-65, 1963.

The thermodynamics and microscopic processes
associated with ions in hot gases are surveyed. Proc-
esses are classified and discussed according to whether
they are charge production, charge conserving or re-
combination processes. Emphasis is placed on specifica-
tion of the important physical variables and magnitudes
governing the various processes. An attempt is made
to describe the present theoretical and experimental
situation in each area and to point out recently-solved
and outstanding unsolved problems.

3097

Yale U. Sterling Chemistry Lab., New Haven, Conn.

RADIATIVE CAPTURE OF ELECTRONS BY
HALOGEN ATOMS, by R. S. Berry and C. W. David.
[1964] [6]p. incl. diagrs. refs. (AFOSR-64-1512)
(AF AFOSR-63-183) AD 446114   Unclassified

Also published in Proc. Third Internat'l. Conf. on
Phys. of Electronic and Atomic Collisions, London

(Gt. Brit.) (July 22-26, 1963), ed. by M. R. C.
McDowell. Amsterdam, North Holland Publishing Co.,
1964, p. 543-548.

This reports the direct spectroscopic observation of
radiative capture of electrons by the free gaseous halo-
gen atoms Cl, Br and I. The spectra were obtained
from emission produced by alkali halides vaporized and
dissociated by shock-heating. The sharp onsets of radia-
tion due to capture of electrons of zero energy are
clearly visible. The radiation intensity dependence near
onset is within experimental uncertainty, consistent
with the photodetachment spectra, the Wigner threshold
law and microscopic reversibility. The continua are
identified by shape and threshold wavelength, and in the
case of Cl and Br, by the presence and wavelength of
continua due to the capture of electrons by atoms in
their excited states. Threshold wavelengths are in good
agreement with the photodetachment thresholds. (Con-
tractor's abstract, modified)

3098

Yale U. [Sterling Chemistry Lab.] New Haven, Conn.

MOLECULAR FRAGMENTS, by R. S. Berry. Final
rept. Nov. 1, 1962-Oct. 31, 1964, 4p. incl. refs.
(AFOSR-65-1213) (AF AFOSR-63-183) Unclassified

The following work was conducted: (1) Spectroscopic
study of free gaseous negative ions; (2) Consolidation
of work on benzene; (3) Generalization of the study of
gaseous polyatomic fragments, their kinetics and
mechanisms of reaction, to include meta and para de-
hydrobenzenes and nitrenes; (4) Generalization of the
negative ion work to the study of radiative capture and
of the theory of electron-molecule collisions; and (5)
Beginning of an investigation of the behavior of charges
in molecular crystals. Publications resulting from
this work are listed.

3099

Yale U. Sterling Chemistry Lab., New Haven, Conn.

DIPOLE ASSOCIATION, by C. Treiner, J. F. Skinner,
and R. M. Fuoss. [1964] [4]p. incl. diagrs. tables,
(AFOSR-65-2381) (AF AFOSR-63-244, AD 626520
Unclassified

Also published in Jour. Phys. Chem., v. 68: 3406-
3409, Nov. 1964.

Dimerization of dipolar solutes in solvents of low dielec-
tric constant is proposed, and a method of determining
association constants (and dipole moments) from dielec-
tric constants and densities is derived. In dioxane,
p-nitroaniline, m-nitrophenol, and pyridinium dicyano-
methylide were found to have association constants of
0.37, 0.8, and 3, respectively. The logarithms of
these constants are linear in the square of the dipole
moments (4.38, 6.91, and 9.2) as expected from theory.
(Contractor's abstract)

3100

Yeshiva U. Belfer Graduate School of Science, New York.

INTEGRAL EQUATIONS AND INEQUALITIES IN THE
THEORY OF FLUIDS (Abstract), by J. L. Lebowitz
and J. K. Percus. [1964] [2]p. (AFOSR-5052)
(AF AFOSR-62-64)   Unclassified

Using the method of functional Taylor expansion de-
veloped previously, an extensive set of equations is ob-
tained for the distribution functions and Ursell functions
in a classical fluid. These include in a systematic way
many previously derived relations. By terminating
the Taylor expansion after a finite number of terms
and retaining the remainder, inequalities are also ob-
tained for the distribution functions and thermodynamic
parameters of the fluid. For the case of positive inter-
particle potentials, inequalities are recovered that were
first found by Lieb. For non-positive potentials, new
inequalities are derived. These inequalities are applied
to the case of a hard sphere fluid in three dimensions.
(Contractor's abstract)

3101

Yeshiva U. [Belfer Graduate School of Science] New York.

EXACT SOLUTION OF GENERALIZED PERCUS-
YEVICK EQUATION FOR A MIXTURE OF HARD
SPHERES, by J. L. Lebowitz. [1964] [5]p. (AFOSR-
64-1918) (AF AFOSR-62-64) AD 450515
                                   Unclassified

Also published in Phys. Rev., v. 133: A895-A899,
Feb. 17, 1964.

The Percus-Yevick approximate equation for the
radial distribution function of a fluid is generalized to
an m-component mixture. This approximation can be
formulated by the method of functional Taylor expansion.
The resulting equation yields correctly the virial ex-
pansion of the pressure up to and including the third
power in the densities and is in very good agreement
with the available machine computations for a binary
mixture. For a one-component system our solution
for $C(r)$ and $g(r)$ reduces to that found previously by
Wertheim and Thiele and the equation of state becomes
identical with that found on the basis of differential
approximations by Reiss, Frisch, and Lebowitz.

3102

Yeshiva U. [Belfer Graduate School of Science] New York.

THE REMAINDER IN MAYER'S FUGACITY SERIES,
by O. Penrose. [1963] [7]p. (AFOSR-64-1975)
(AF AFOSR-62-64) AD 452507   Unclassified

Also published in Jour. Math. Phys., v. 4: 1488-1494,
Dec. 1963.

Upper and lower bounds are obtained for the remainder
after a finite number of terms of the expansions in
powers of fugacity z for the pressure p, the s-particle
distribution functions, the density ρ, and the fugacity

coefficient z/ρ for a system of particles with two-body
interactions. The interaction potential must be either
nonnegative or else have a hard core and decrease
faster than r^{-3} at large distances. The results hold for
all positive z, and apply to lattice gases as well as to
fluids. For nonnegative potentials, the results imply
that successive partial sums of each of these fugacity
expansions provide alternate upper and lower bounds,
valid even if the series diverges, on the physical quan-
tity the expansion represents.

3103

Yeshiva U. [Belfer Graduate School of Science] New York.

AVERAGE DENSITY APPROXIMATION FOR THE
RADIAL DISTRIBUTION FUNCTION OF A FLUID, by
J. L. Lebowitz and E. Praestgaard. [1964] [8]p.
(AFOSR-64-2303) (AF AFOSR-62-64) AD 452410
                                   Unclassified

Also published in Jour. Chem. Phys., v. 40: 2951-
2958, May 15, 1964.

The radial distribution function of a fluid, $g(r)$, is
directly related to the difference between the work
$W(r,p)$ necessary to introduce an extra particle at a
distance r from the known position of a particle, and the
work $W(p)$ of introducing a particle at an arbitrary point
in the fluid. Now a system in which one particle is kept
fixed can be thought of as a nonuniform system with
density $pg(r)$. This suggests that $W(r,p)$ can be written
as $W(p)$ where $p(r)$ is some appropriate effective local
density. When the equation is solved in a virial expan-
sion it yields reasonably good results for the first few
terms. A linearization of this equation leads to an
integral equation of the type considered by Kirkwood
who was first to consider this type of approximation.

3104

Yeshiva U. [Belfer Graduate School of Science] New York.

THERMODYNAMIC PROPERTIES OF MIXTURES OF
HARD SPHERES, by J. L. Lebowitz and J. S. Rowlinson.
[1964] [6]p. (AFOSR-64-2312) (AF AFOSR-64-508)
AD 452383   Unclassified

Also published in Jour. Chem. Phys., v. 41: 133-138,
July 1, 1964.

Investigation has been made of the thermodynamic
properties of a binary mixture of hard spheres (with
special reference to the existence of a phase transition)
by using the recently obtained exact solution of the gen-
eralized equations of Percus and Yevick for the radial
distribution functions of such a mixture. The distribu-
tion function obtained from the equations of Percus and
Yevick is only an approximation and so yields two differ-
ent pressures when used, respectively, in the compres-
sibility equation of Ornstein and Zernike and in the equa-
tion of state obtained from the virial theorem.

3105

Yeshiva U. Belfer Graduate School of Science, New York.

CONVERGENCE OF VIRIAL EXPANSIONS, by J. L. Lebowitz and O. Penrose. [1964] [7]p. incl. refs. (AFOSR-65-0109) (AF AFOSR-62-64) AD 455780
Unclassified

Some bounds are obtained on R(V), the radius of convergence of the density expansion for the logarithm of the grand partition function of a system of interacting particles in a finite volume V, and on R, the radius of convergence of the corresponding infinite-volume expansion (the virial expansion). For potentials with hard cores the maximum density is an upper bound on R(V), though possibly not on R; an example shows how both R(V) and R can be less than the maximum density, even if there is no phase transition. A theorem is proved, analogous to Yang and Lee's theorem on uniform convergence in the complex z plane, defining a class of domains in the complex ρ plane within which the operations $V \to \infty$ and d/d_p commute. This theorem is used to show that $\lim_{V \to \infty} R(V) \leq R$, and that there is no phase transition for $0 \leq \rho < 0.28952/(u + 1)B$. (Contractor's abstract, modified)

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The following is a list of all AFOSR reports to which control numbers were assigned and which were actually issued during this period. All omissions are deliberate; the absence of a number implies that the report assigned that number was never published.

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